PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

G Dallas Hanna Anniversary Volume

Vol. XXXII, No. 7, pp. 149–218, 28 figs., 3 tables May 20, 1963

CENTRODERA SPURCA (LECONTE) AND TWO NEW SPECIES RESEMBLING IT, WITH BIOLOGICAL AND OTHER NOTES (COLEOPTERA: CERAMBYCIDAE)

by

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Introduction

Centrodera spurca (LeConte) is one of the few large Cerambycidae attracted to light during the relatively cool evenings of the Pacific Coast of Canada and the United States. Of the species so taken, the only ones likely to be confused with it are those described as new in this paper, plus *Ortholeptura valida* (LeConte) and *O. insignis* Fall[1] (fig. 1).

A big brownish beetle with antennae fully an inch long in the male (fig. 2), crawling up the glass or buzzing through an open window after dusk, is enough to excite most collectors. Having taken the species in British Columbia I greeted those which landed on my windows in Mill Valley, California, as old friends, but bottled them just the same. The first came in mid-May, 1948, and it did not take long to build up an adequate series. Those which followed in June and July were not collected, but in late August I finally realized that the beetles on the windows were smaller than usual and had a different facies. Comparison with the earlier set confirmed that there were two species, and examination of material in collections showed that both had been identified as *C. spurca* for many years. In fact the example used for the drawing in R. Hopping's paper on the Lepturini (1937, pl. III, fig. 4) proved to be the new species.

Knowing of my interest in these large centroderas, Willis C. Day collected some at light along the Scott river in northern California in August, 1949, and they turned out to be a second new species. A larger series of this from adjacent Oregon was soon submitted by Arthur T. McClay. From their known distribution the two new species are allopatric, but *C. spurca*

1. Swaine and R. Hopping (1928, p. 38) synonymized *Ortholeptura* Casey under *Anoplodera* Mulsant, but Linsley (1942, p. 51) raised it to generic status again.

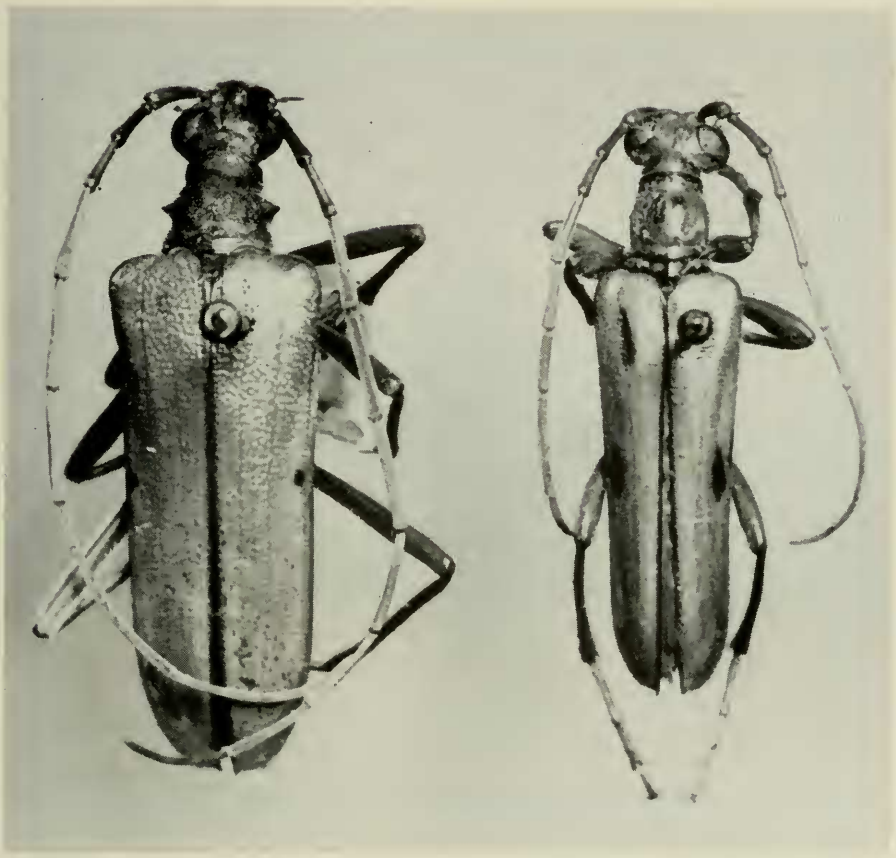


Figure 1. Males of *Centrodera spurca* and *Ortholeptura valida*, two species which are attracted to light in many of the same areas. The short legs and unarmed prothorax distinguish *Ortholeptura* at a glance.

is sympatric with both of them. The three are almost enough alike to be called sibling species, but probably were confused because *C. spurca* is so distinctive and easily recognized that nobody bothered to examine a series critically.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge help from the owners of private collections, and the persons in charge of institutional collections, who have loaned specimens for study; their names are listed below with the letters used to designate the collections, many of which are referred to in the text.

In addition, the following persons have generously given their time to answer questions, compare specimens with types, or verify other data:

Figure 2. A male of *Centrodera spurca* on a leaf of madroño, at night; the beetles are nocturnal.

R. P. Allen, J. Balfour-Browne, W. F. Barr, R. S. Beal, Jr., P. J. Darlington, Jr., W. C. Day, K. M. Fender, L. G. Gentner, G. A. Hardy, J. N. Knull, G. Kuschel, F. Lane, J. D. Lattin, the late G. P. Mackenzie, P. Rubtzoff, J. Sedlacek, the late G. Stace Smith, P. J. Spangler, P. C. Ting. Through the kindness of P. D. Hurd, Jr., I have been able to use a base map prepared for the California Insect Survey of the Department of Entomology, The University of California, Berkeley. E. G. Linsley and J. A. Chemsak have read the manuscript, but the responsibility for any remaining errors is of course mine. Help by members of my family in field work is equally appreciated. E. L. Kessel kindly took two of the photographs.

AHH A. H. Howden, Ottawa, Ontario.

BM B. Malkin; collection now in the Chicago Natural History Museum.

CAS California Academy of Sciences, San Francisco; includes specimens from many private collections, such as those of E. C. Van Dyke, F. E. Blaisdell, E. G. Linsley, J. O. Martin, J. W. Green, R. Hopping.

CIS California Insect Survey, University of California, Berkeley (P. D. Hurd, Jr., J. A. Powell, J. A. Chemsak).

CNC Canadian National Collection, Ottawa, Ontario (H. Howden).

DG D. Giuliani, San Anselmo, California.

DR	D. Rentz, Novato, California.
GHN	G. H. Nelson, Colton, California.
ILR	I. LaRivers, Reno, Nevada.
JGE	J. G. Edwards, San Jose, California.
JNK	J. N. Knull, Ohio State University, Columbus, Ohio.
JS	J. Schuh, Klamath Falls, Oregon.
LACM	Los Angeles County Museum, Los Angeles, California (F. S. Truxal).
LGG	L. G. Gentner, Medford, Oregon.
ML	M. Lundgren, Oakland, California.
OHSU	Ohio State University, Columbus, Ohio (J. N. Knull).
OSDA	Oregon State Department of Agriculture, Salem, Oregon (K. Goeden).
OSU	Oregon State University, Corvallis, Oregon (J. D. Lattin).
PMV	Provincial Museum of Natural History, Victoria, British Columbia (G. A. Hardy).
RBH	R. B. Hutt, Pullman, Washington.
RWD	R. W. Dawson, Pullman, Washington.
SDNHM	San Diego Natural History Museum, San Diego, California (G. Marsh and C. F. Harbison).
SJSC	San Jose State College, San Jose, California (J. W. Tilden and J. G. Edwards).
SRP	S. R. Piazza, San Jose, California.
UBC	University of British Columbia, Vancouver, British Columbia (G. J. Spencer and G. G. E. Scudder; now includes the G. Stace Smith collection).
UCD	University of California, Davis, California (A. T. McClay; includes material from his own collection).
UI	University of Idaho, Moscow, Idaho (W. F. Barr and A. Walz).
USF	University of San Francisco, San Francisco, California (E. L. Kessel).
USNM	United States National Museum, Washington, D. C. (P. J. Spangler; selected specimens).
UW	University of Washington, Seattle, Washington (M. H. Hatch; the M. H. Hatch and K. M. Fender collections are included in the University collection).
WSU	Washington State University, Pullman, Washington (M. T. James).
	W. E. Hazeltine, W. R. Bauer and J. S. Buckett collected and donated specimens.

Genus **CENTRODERA** J. L. LeConte

Centrodera LeConte, 1850. Jour. Acad. Nat. Sci. Phila., 2nd Ser. (N. S.), vol. 1, no. 4, p. 325; LeConte, 1862. Proc. Acad. Nat. Sci. Phila., 1862, pp. 38, 41; Lacordaire, 1869. Hist. nat. insectes, vol. 8, pp. 426, 432; Provancher, 1877. Petite faune ent. Canad., vol. 1, pp. 580, 606; LeConte, 1873. Smithson. Miscell. Coll., no. 265, p. 328; LeConte and Horn, 1883. Smithson. Miscell. Coll., no. 507, p. 313; Wickham, 1897A. Canad. Ent., vol. 29, no. 4, p. 88; Blatchley, 1910. Coleopt. Indiana, p. 1046, Swaine and R. Hopping, 1928. Nat'l. Mus. Canada, bull. no. 52, pp. 10, 14; Bradley, 1930. Manual gen. beetles, p. 235; Chagnon, 1936. Le Nat. Canad., vol. 63, nos. 8 and 9, p. 205; R. Hopping, 1937. Nat'l. Mus. Canada, bull. no. 85, p. 10; Knull, 1946. Ohio Biol. Survey Bull. 39, pp. 151, 174; Jaques, 1951. How to know the beetles, p. 255.

Centrodera subgenus *Apatophysis* Chevrolat, Gressitt, 1951. Longicornia, vol. 2, p. 48.

Parapachyta Casey, 1913. Mem. Coleopt., vol. 4, pp. 216–217.

It was J. Thomson (1864, p. 145) who designated *Rhamnusium ? decoloratum* Harris, 1841, as the type-species of *Centrodera* LeConte. Swaine and R. Hopping (1928, p. 10) apparently overlooked this, and stated the type-species to be "*(Rhagium) decoloratum* Harris," by monotypy. In fact, LeConte cited and described two species following his description of *Centrodera* (p. 325; *Centrodera* was actually first given in the key on p. 316, but without included species, and cited as *Centroderus* by error on p. 312): 1. *C. decolorata*, with synonyms "*Rhamnusium ? decoloratum!* Harris Ins., *Toxotus rubidus*, Dej. Cat., *T. rubidus* [*rudibus* in Haldeman's original description, by a printer's error], Hald. 58," from Niagara and Massachusetts. 2. *C. picta*, with the reference "*Toxotus pictus* Hald 58," from Pennsylvania and South Carolina.

It is surprising that Haldeman and LeConte did not include the generic name *Centrodera* in their editing of the Melsheimer Catalogue, since in their part of the Preface (1853, p. viii) they stated that so far as known to them their additions to the original manuscript "include all the species published up to January, 1852."

Casey (1913, p. 216) proposed *Parapachyta* for "*Pachyta spurca* Lee., a large pallid and coarsely sculptured species of the true Pacific coast fauna." Dr. Paul Spangler has been so kind as to examine Casey's series for me, and reports "In the Casey collection are four specimens under the name *Parapachyta spurca* LeC. These agree with our *C. spurca* with the strongly recurved hair on the base of the elytra and the hind margin of the 5th sternite very distinctly margined. Apparently Casey had LeConte's *spurca*."

Gressitt (1947, p. 191) said that the Old World genus *Apatophysis* Chevrolat, 1860, probably should be considered a subgenus of *Centrodera*

LeConte, 1850. Four years later (1951, pp. 48–50) he so placed it, without further comment, and without giving characters to distinguish it from the nominate subgenus.

According to Gahan (1906, pp. 68, 69) a characteristic of the species of *Apatophysis* is that the males have the antennae "serrate," *i.e.* segments 5 to 10 "compressed to a sharp edge in front and angulate at the apex." In the two males I have seen, one identified as *A. sinica* A. Semenov-Tian-Shanskij, the other as *A. servicornis* (Gebler), both have antennal segments 6 to 10 distinctly produced at the outer apical angle, and the elytra are rather densely covered with fine, short hairs. The females are said to be less pubescent than the males, or even glabrous, and to have the elytra a little shortened, exposing the last one or two abdominal segments, thus resembling prionines. Figures of both sexes of *A. barbara* Lucas are given by Villiers (1946, p. 39, figs. 107, 108).

In the described species of *Centrodera* the elytral hairs all arise from the coarse elytral punctures. In the two males of *Apatophysis* mentioned above, it was at once apparent that the elytral vestiture arises from all over the interspaces *between* the coarse punctures, but few or none actually from them. Dr. Frederico Lane has been so kind as to check this character in the species of *Apatophysis* in the collections of the British Museum (Nat. Hist.): *A. toxotoides* Chevrolat, 1 male (and a female marked *? barbara* Lucas), Sahara; *A. caspica* Semenow, 2 males from Afghanistan, possibly syntypes; *A. kamarowi* Semenow, 1 male, Turkestan; *A. modica* Gahan, 2 male syntypes, one marked *type; A kashmiriana* Semenow, 9 males and 3 females, Kashmir; *A. montana* Gahan, the male type, West Himalayas. He summarizes his notes (letter of April 15, 1962) as follows: "All species of *Apatophysis* examined have vestiture on the interspaces, and exceptionally a few hairs as well in the coarser punctures." He also suggests that the palpi may offer characters for the generic separation of *Apatophysis* and *Centrodera*.

On the bases of the differences in the elytral vestiture, the antennae of the males, the body form and elytra of the females, and the distribution, I believe that the species of *Apatophysis* are generically distinct from those of *Centrodera*.

Gressitt cited the type-species of *Apatophysis* as *Leptura servicornis* Gebler, 1843; but Thomson (1864, p. 147) designated *A. toxotoides* Chevrolat, 1860. Actually, the generic name was monotypic upon proposal, since in both Chevrolat's preliminary (1860A, p. 96) and formal (1860B, p. 304) descriptions of *A. toxotoides,* no other species was mentioned in combination with the name *Apatophysis*.

Van Dyke (1927, pp. 102–103) gave a key to the Pacific Coast species of *Centrodera,* but did not include *C. spurca* (LeConte).

Swaine and R. Hopping (1928, p. 14, footnote 2) remarked that "The genus *Centrodera* Lec. is doubtfully distinct from *Xylosteus* Friv."; later (1937, p. 14) R. Hopping wrote "The comparatively small eyes and type of maculation will not allow it [*i.e.* the only American species, *X. ornatus* LeConte, 1873] to be placed in the genus *Centrodera,* although *C. picta* somewhat approaches this species in maculation." Gressitt (1947, p. 191) removed *X. ornatus* from *Xylosteus* to the genus *Leptorhabdium* Kraatz, 1879.

Male Genitalia

In describing the curved male genital organ of *Centrodera spurca* (fig. 12) one faces the problem of deciding which side is morphologically dorsal and which ventral. Because of the curvature, the organ lies on its side when at rest in the abdomen, and is rotated during protrusion. This problem has been referred to by Lindroth and Palmén (1956, p. 72) who state "The simplest method is no doubt to speak about dorsal side, left side etc. according to the position of the organ when extended and in activity. We propose that, if necessary, the original (morphological) position of the aedeagus and its details be expressed by the terms *eu-dorsal, eu-ventral, eu-dextral, eu-sinistral.*"

Even this is not as simple as it sounds. Guignot (1931, p. 53), discussing the male genitalia of Dytiscidae, in which the organ rests on its side, wrote "Au moment de l'érection, l'*aedeagus,* tout en faisant saillie par la fente génitale, tourne de 45° sous l'influence de ses muscles rotateurs. C'est dans cette position simple d'érection (et non pas au moment de l'introduction dans le vagin de la femelle, car alors le mouvement s'exagère et la pointe du pénis devient presque antérieure) que sont faites toutes les descriptions, et elles deviendraient incompréhensibles, si on ne se figurait pas nettement la position de l'organe. A ce moment la base du pénis est antérieure, la sommet est postérieur, le bord convexe est dorsal et le bord concave ventral; un paramère se trouve à droite et le second à gauche, le tegmen est dorsal et plus ou moins à droite."

But F. Balfour-Browne (1940B, pp. 126–128, figs. 2–4; see comparable figs. in his 1932 book, p. 45, and pp. 23–24, fig. 6, in his 1940A book), also discussing the Dytiscidae, draws the opposite conclusion: that the convex side is ventral, the concave dorsal. His argument is based in large part in conditions in typical hydrophilids, *Hydrophilus* spp. and *Hydrobius fuscipes* (Linnaeus), in which the genital organ is flattened dorso-ventrally and lies flat in the abdomen. He states (*loc. cit.,* p. 126, with reference to fig. 1 on p. 127) "An examination of the aedeagus of an Hydrophilid, where there can be no question as to which is the dorsal side, shows that the opening of the ejaculatory duct, the 'gonopore,' is always on the ventral side

below the apex. In the Hydradephaga [which includes the Dytiscidae], the gonopore is on the convex side." On the other hand G. Kuschel, who has made detailed comparative studies of the genitalia in the Curculionidae, and investigations in other families of the Phytophagoidea, has found (verbal communication, 1962), that on the basis of muscular and other attachments of the genital capsule as it lies at rest in the abdomen, the opening through which the intromittent organ is everted is always on the (morphologically) true dorsal side.

The person who has studied the male genitalia of the Coleoptera most broadly is R. Jeannel. The organs were used extensively in Jeannel and Paulian's 1944 classification of the Order, but it is in Jeannel's 1955 paper that the subject is discussed and illustrated most fully. The range of structural variety shown is truly amazing, and suggests at once that it may not be possible to give a statement as to which side is dorsal, and have it apply universally. This is verified in Jeannel's discussion of the tubular type of median lobe, which consists of two longitudinal sclerites, one of which surpasses the other and forms the "apex," as in *Centrodera* spp. He says (p. 22) "On comprend ainsi que l'apex étant formé tantôt par la paire sternale, tantôt par la paire tergale, l'orifice apical sera tergal ou sternal par rapport à l'apex, selon les cas." In *Centrodera* the orifice near the apex of the aedeagus is comparable to Jeannel's figure 5 of a trechid, and thus dorsal, *i.e.* the convex side of the aedeagus is dorsal. This is in agreement with figures by Villiers (1946, p. 8), Ehara in his major paper on the male genitalia of Japanese Cerambycidae (1954), and most others who have illustrated the organs of this family.

There is another basic subject upon which published opinions differ greatly, and that is the nomenclature of the parts of the genital capsule. In the classical study Sharp and Muir (1912) used the very descriptive terms median and lateral lobes, the whole being the aedeagus, but pointed out that the "lateral lobes" are not always lateral, and the term is thus inappropriate; paramere and tegmen were suggested. Jeannel (1955) followed Sharp and Muir. Lindroth and Palmén (1956) and Lindroth (1957) prefer penis and tegmen, the outer parts of the tegmen being the parameres. Snodgrass (1957) uses aedeagus for the median lobe of Sharp and Muir, and parameres for the lateral lobes; I am following his usage. Other views to be considered are found in papers by Gilbert (1953), Wood (1953) and Michener (1956).

In *Centrodera decolorata* the genital armature is elongate and only slightly curved, so it is able to lie on its ventral (concave) surface when retracted into the abdomen, and is merely extruded, then bent downward and forward, to be in position for copulation. In *C. spurca* and allies, it is more strongly curved (figs. 12, 16, 17) and is nearly always found lying on its

left side, *i.e.*, with its apex pointing to the right side of the abdomen, though occasionally almost as in *C. decolorata*. During protrusion for copulation, an armature previously on its side must make a twist of 90 degrees. In *C. nevadica* and other small western species examined it lies on its left side when retracted.

KEY TO THE SPECIES OF THE *Centrodera spurca* GROUP

1. Elytral vestiture (in profile; fig. 3) inconspicuous, the hairs short, strongly recurved, decumbent. Fifth abdominal sternite with hind edge differentiated, narrowly thickened, usually clearly margined apically[2] and narrowly to base

Figure 3. *Centrodera spurca*. Part of an elytron to show the inconspicuous vestiture of short, recurved, decumbent hairs.

at sides (fig. 5), often emarginate or broadly subcrenulate, especially in female. Elytral apices each normally with small tooth at sutural angle. Outer antennal segments of male smooth, satiny (fig. 6). Larger species, males averaging 22 mm. in length, females 25 mm. An early season species, late March—early August, commonest in June and July; widespread, southern British Columbia and northern Idaho to southern California (fig. 14).....*C. spurca*

— Elytral vestiture not very conspicuous, with some recurved hairs, but most of those in basal half standing out freely at an angle (fig. 4). Fifth abdominal sternite with at most an unobtrusive fine margin at apex in female. Elytral

2. Not appreciably margined in only four specimens of a total of 1061 studied; these are all females from Washington and California.

Figure 4. *Centrodera dayi*. Profile of an elytron, showing the suberect vestiture.

apices not toothed at sutural angles. Outer antennal segments of male slightly to obviously bristling (figs. 7, 8). Smaller species, males averaging 17 mm. in length, females 18 mm. Later appearing species, June – September, commonest in August; distribution either adjacent to the Cascade mountains from southern Washington to the Klamath mountains and western foothills of the Sierra Nevada of California, or along the coast of California only.....2

2. Front tarsus notably short and broad (fig. 9). Hind tarsus comparatively short, first segment very gradually widened from base to apex, appreciably broadened apically; second segment noticeably triangular, flattened dorsally (fig. 10). Male with short and appreciably cuneate elytra (fig. 11), antennae with segments 6 to 11 and apical half of 5 with exceedingly short, fine, almost decumbent hairs, the general effect at × 25 fairly smooth (fig. 7). Elytra of female almost straight-sided (fig. 11). Known from southern Washington to the foothills adjacent to the Central Valley of California (figs. 14, 15).....*C. dayi*

— Front tarsus more elongate, narrower (fig. 9). Hind tarsus with first segment long, parallel-sided, very slightly broadened apically; second segment elongate, very gradually widening from base to apex, rounded on top (fig. 10). Male with gradually narrowing, nearly parallel-sided elytra, outer antennal segments at × 25 bristly (fig. 8). Female with elytra narrowed behind humeri then widened again (fig. 11). Known only from the coast of California (fig. 15).....*C. autumnata*

Centrodera spurca (LeConte)

Toxotus spurcus LeConte, 1857. Rept. ins. coll. survey, p. 63 (this is a preprint of the following item); LeConte, 1860. *In:* Reports expl. survey . . . Mississippi . . . Pacific Ocean, vol. 12, part 3, p. 63; Lacordaire, 1869. Gen. coleopt., vol. 8, p. 439, footnote 1; LeConte, 1870. Ann. Mag. Nat. Hist., ser. 4, no. 35, vol. 6, p. 402.

Pachyta spurca LeConte, Leng, 1890. Ent. Amer., vol. 6, part 5, pp. 97, 98; Fall, 1901. Occ. Pap. Calif. Acad. Sci., vol. 8, p. 148; Garnett, 1918. Canad. Ent., vol. 50, part 6, p. 212.

Parapachyta spurca LeConte, Casey, 1913. Mem. Coleopt., vol. 4, p. 216; Hardy, 1926A. Rept. Provin. Mus. (1925), p. C 28, pl. IV, fig. 3; Hardy, 1926B. Ceram. Vanc. Isl., p. 5, pl. IV, fig. 3; Essig, 1926. Ins. West. N. Amer., p. 452; Moore, 1937. Occ. Pap. San Diego Soc. Nat. Hist., vol. 2, p. 88.

Pachyta (Parapachyta) spurca LeConte, Doane *et al.*, 1936. For. Ins., pp. 176–177.

Centrodera spurca LeConte, R. Hopping, 1937. Nat'l. Mus. Canad., bull. 85, p. 11 (in part, but not the fig. [4] on pl. III, for which see *C. autumnata);* Hardy, 1942. Proc. Ent. Soc. Brit. Col., vol. 39, p. 10.

Evodinus spurcus J. Leconte, Aurivillius, 1912. *In:* Coleopt. Catal., Pars. 39, p. 188; Saalas, 1936. Ann. Zool. Soc. Zool.-Bot. Fenn. Vanamo, vol. 4, no. 1, p. 73.

Evodinus (Centrodera) spurcus, Saalas, 1936. Ann. Zool. Soc. Zool.-Bot. Fenn. Vanamo, vol. 4, no. 1, p. 82.

Typocerus cervinus Walker, 1866. *In:* Lord's Nat. Vanc. Isl. and Brit. Col., vol. 2, p. 332.

Centrodera spurca was described as from Steilacoom, Washington Territory; this is in what is now Pierce County, just southwest of Tacoma, Washington. However, on page 23 of the same paper LeConte recorded it from Oregon; this is explained by his statement on page 3: ". . . (and Washington Territory, which is, for purposes of convenience, always included when Oregon is referred to in these pages) . . ." The type is a female,

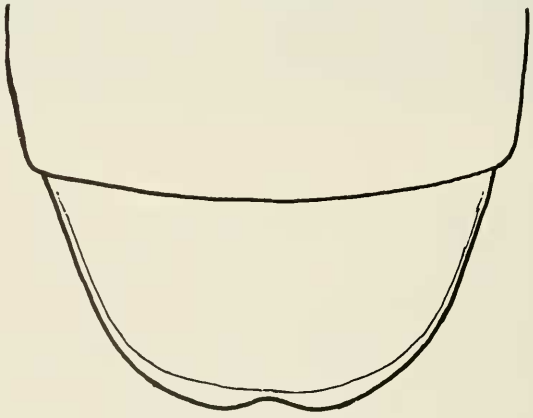


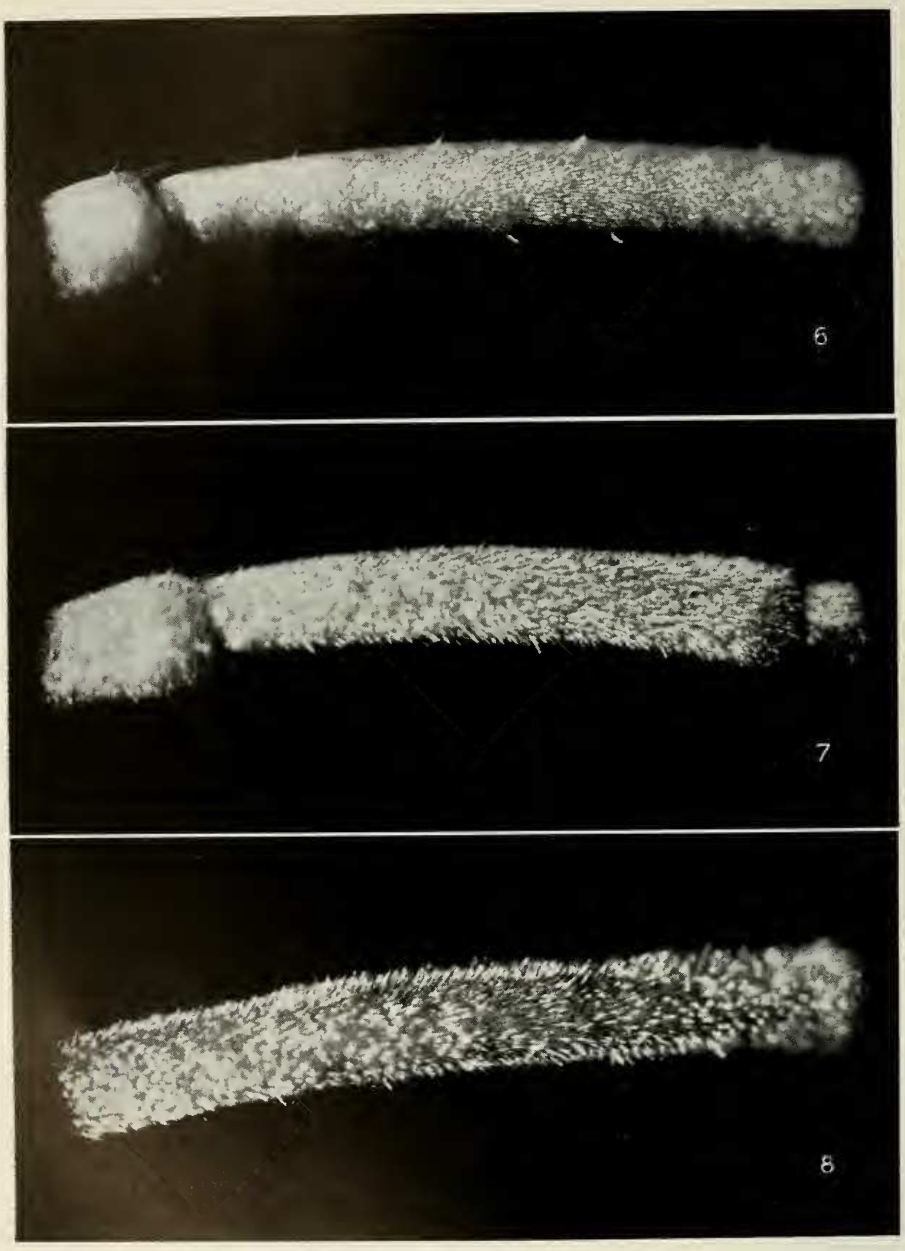
Figure 5. *Centrodera spurca.* Fourth and fifth abdominal sternites of a female, the fifth distinctly margined.

and there is a female before me which was compared with it in 1949 by P. J. Darlington, Jr.

The type of *Typocerus cervinus* Walker is in the British Museum (Nat. Hist.), and the museum's Accession Catalogue entry 64–18 shows "British Columbia Coll. Boundary Commission Colleetor J. K. Lord Esq." LeConte examined it and synonymized it (1870, p. 402) with his *Toxotus spurcus.* Frederieo Lane was so kind as to compare a female of *C. spurca* with Walker's specimen, which has three labels on the pin: 1. Type, 2. $\frac{\text{Brit}\ 64}{\text{Colum}\ 18}$, 3. cervinus [in Walker's handwriting]. The type is 24.25 mm. long, 8.5 mm. wide at the humeri; the antennae are approximately 21.25 mm. long, the elytra 19 mm., the fifth abdominal sternite is margined and slightly emarginate apically, and each elytron has a small spur at the sutural apex. These characters are all in agreement with those of a medium-sized female of *C. spurca,* with which speeies it was synonymized by LeConte in 1870 and by Leng in 1890.

It is puzzling that Leng, in his 1890 synopses of the Cerambycidae, put *C. spurca* in *Pachyta,* since a specimen will traee eorreetly to *Centrodera* in his generie key (p. 65), which was taken from LeConte and Horn's 1883 "Classifieation," it in turn having been taken from LeConte's 1873 "Classification."

MALE. *Form* elongate, broadest at humeri, elytra gradually narrowing from base to truneate apex (fig. 11). *Length* 19 to 26 mm., average 22.2 mm.; width at humeri 5 to 7 mm., average 6.02 mm. Elytra pale yellowish-brown, with luminous golden sheen from reflection of their shagreened under surfaee seen through the almost transparent upper surfaee (and resembling the glow seen in some well-worn micaceous sehist stones); usually with a rounded black or brownish antemedian dot near side, showing dorsally on each elytron but actually on lower surfaee; thorax, head, antennae, legs, and undersurfaee a little darker, pale reddish-brown, eyes and tips of mandibles black; pubeseenee golden yellow. *Head* densely, irregularly, moderately eoarsely punctate dorsally, most eoarsely between eyes where, as on elypeus, surfaee may be somewhat rugulose; each puncture on mandibles, labrum, elypeus, front, oeciput, and undersurfaee of head giving rise to a hair; mid-cranial suture an impressed line from base of elypeus to declevity between eyes; width of vertex between eyes a little greater than width of an eye. Antennae longer than body, usually surpassing apiees of elytra by segments 10 and 11, apical (11th) segment usually constricted at apical five-sevenths, giving the illusion of a twelfth segment; segment eleven one and one-half times as long as scape and three-fifths longer than first segment of hind tarsus; scape with moderately long appressed hairs, and sparse scattered shorter hairs which stand out at an



Figures 6–8. Ninth antennal segments of males of three species of *Centrodera*. Fig. 6. *C. spurca;* the fine hairs are closely appressed, the sensory hairs stand out clearly. Fig. 7. *C. dayi;* the fine hairs are not decumbent yet only partially obscure the longer sensory hairs. Fig. 8. *C. autumnata;* the fine hairs are semierect and almost as long as the sensory hairs, giving a bristly appearance.

angle of about 45 degrees, segments 2 to 5 with progressively shorter appressed vestiture, segments 6 to 11 with a dense covering of short appressed hairs lying parallel to the length of the segments, with occasional short sensory hairs projecting at about 45 degrees (fig. 6), the effect at about 10 × being as of satin, *i.e.* holoserieeus. Inflated disk of *pronotum* a little more coarsely and closely punctured than is head between eyes, each puncture

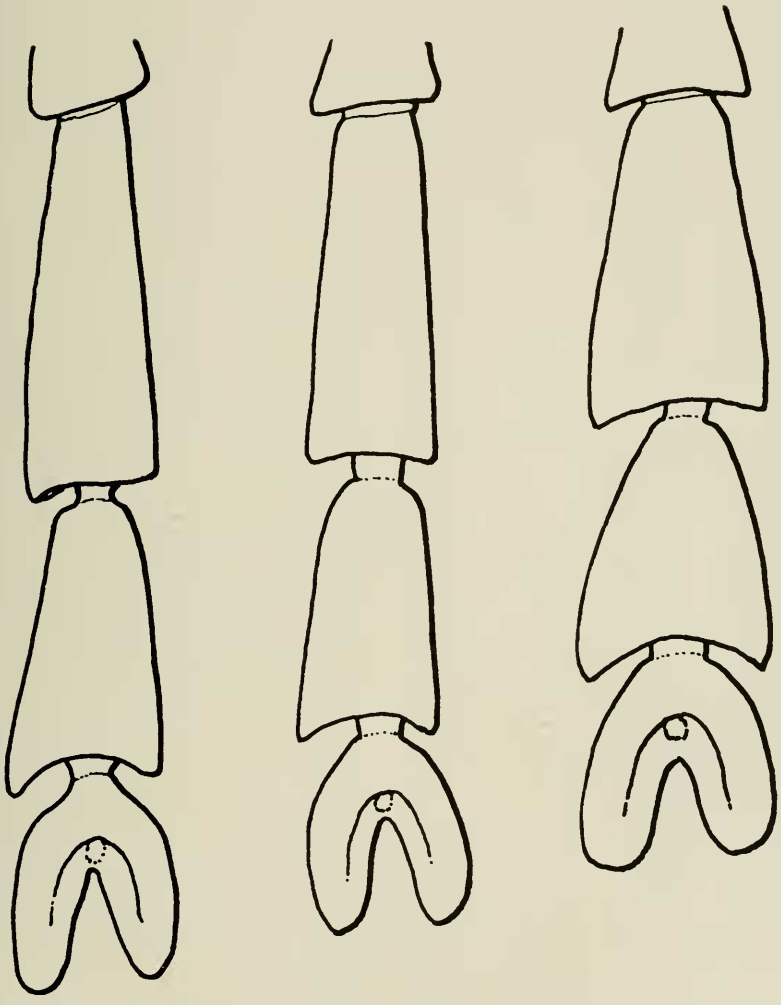


Figure 9. Basal three segments of the front tarsi of *Centrodera spurca*, *C. autumnata* and *C. dayi* to show relative lengths and widths; vestiture and punctation omitted.

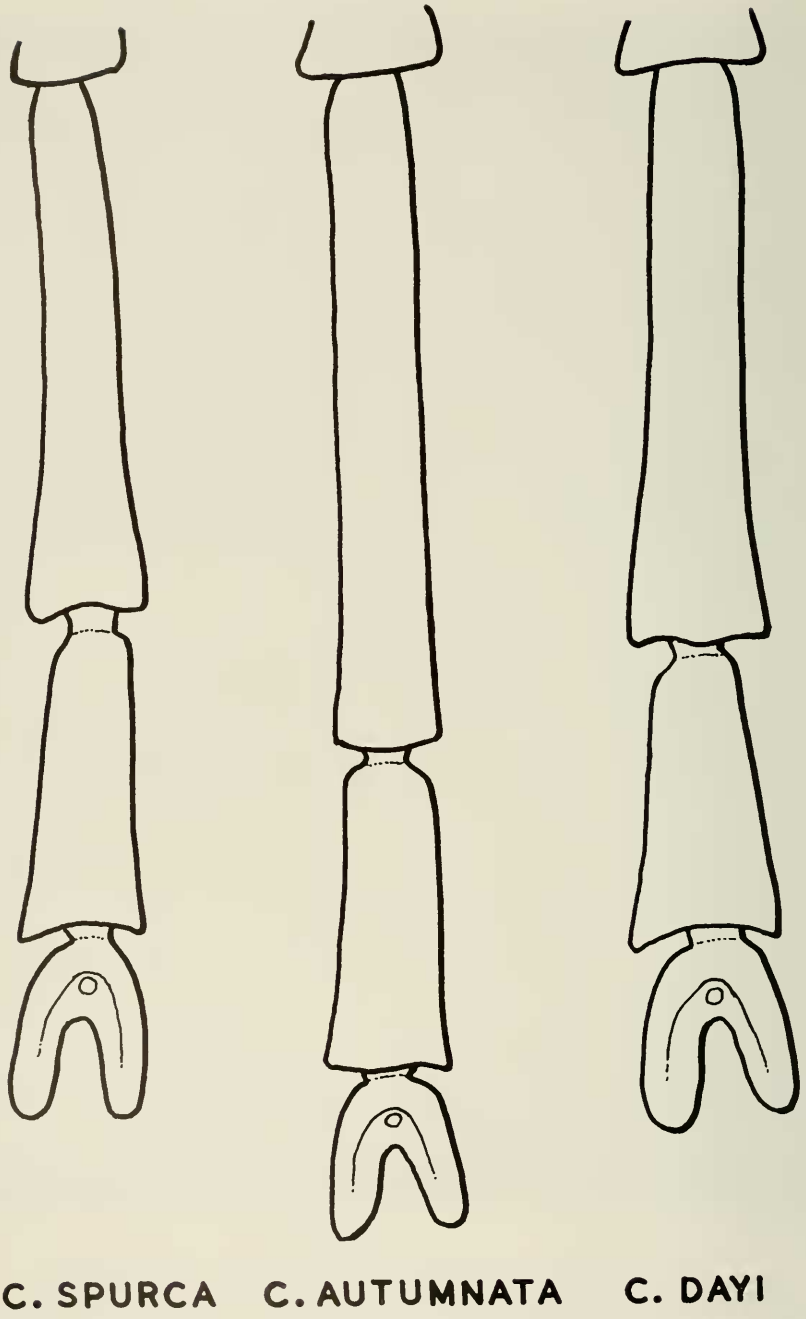


Figure 10. Basal three segments of the hind tarsi of *Centrodera spurca*, *C. autumnata* and *C. dayi;* punctation and vestiture omitted.

with a fine recurved hair, except at sides near base where some of the hairs are long and projecting; lateral tubercles slightly antemedian. *Elytral* width at humeri, to length, about as is 7.3 to 17.7; coarsely closely punctured at base, except on humeri, and progressively less coarsely and more shallowly punctured from base toward apex, each puncture giving rise to a short fine recurved hair; elytral apices truncate, sutural angles usually with a small blunt spine. *Abdominal sternites* clothed with fine appressed golden hairs which do not obscure surface, and sparse longer and less decumbent hairs, especially at apices of segments and along median line. Fifth visible abdominal sternite distinctly thickened and margined apically, margin extending narrowly along sides nearly to base, apex usually broadly emarginate and a little impressed at middle; pygidium emarginate apically. Hind femur reaching to slightly beyond apical eighth of elytra, vestiture of hind margin short, even; first segment of hind tarsus as long as segments 2 and 3 combined, segment 1 gradually widening from base to apex, segment 2 one and a half times as wide at apex as at base (fig. 10). *Male genitalia:* On the basis of the orientation accepted in the general discussion of the male genitalia, earlier in this paper, the genital armature lies on its left side in the abdomen. Aedeagus tubular, elongate, curved (fig. 12A), basal third bilobed in dorsal view (fig. 12D); apical two-thirds longitudinally divided into dorsal and ventral sclerites which can gape apart but are actually joined by a pliable membrane (figs. 12A, 12B, stippled area), ventral side longer than dorsal, more strongly sclerotized and slightly hooked apically; sclerotized area of apical two-thirds of dorsal side narrowing apically, with area along each side of median line differentiated, *i.e.* more strongly sclerotized and darkened, ending in slightly spreading bifid prominences (figs. 12A, 12B). Intromittent organ, when everted, about as long as aedeagus, with two irregularly shaped armatures (when the endophallus is retracted and folded within the aedeagus the pair of armatures appear as in fig. 13, but when it is extruded and inflated to to its full dimensions the two armatures are on opposite sides and separated by a distance equal to the length of one of them), and a pair of small, nearly quadrate rasp-surfaced areas. Tegmen elongate, slightly curved, encircling aedeagus (as in fig. 17) at about mid-point, but independently moveable; apical third thickened, flattened, developed into two separate parameres, each with dense reddish-brown hairs on outer edge and apex (fig. 12C) but having only about 50 thin paler hairs on its inner or ventral surface; basal ends not coalesced, but fitting into hollow of basal third of ventral surface of aedeagus, as in fig. 17A.

FEMALE. Length 20 to 30 mm., average 24.9, width at humeri 6 to 8.5 mm., average 7.3. Form stouter than in male, elytra almost paralled-sided in basal five-sixths. Antennae shorter than in male, barely reaching to

apical sixth of elytra; 11th segment as long as scape, not constricted; antennal vestiture as in male.

VARIATION. There are occasional specimens in which the elytra show six or seven narrow paler lines; these are on the lower surface and show

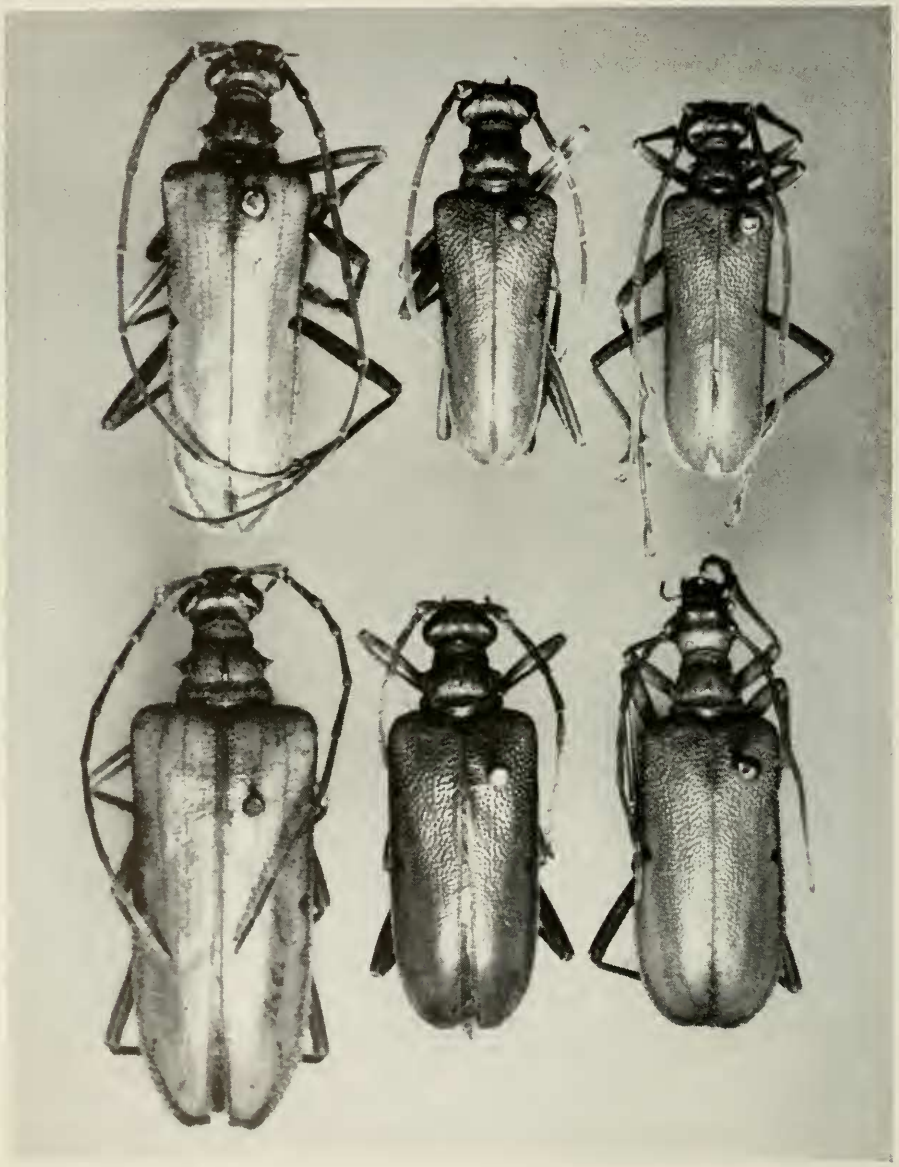
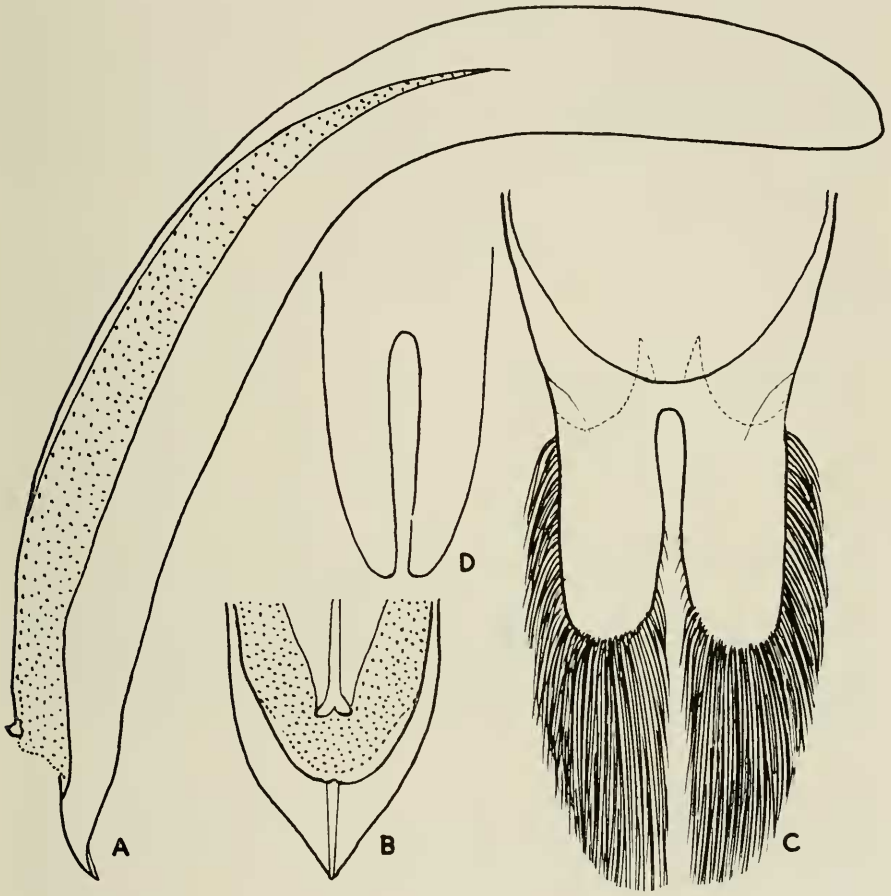


Figure 11. Males (upper row) and females of *Centrodera spurca*, *C. dayi* and *C. autumnata*, respectively.

through to give the appearance of light vittae. Most examples seen have been from the northeastern distribution of the species.

The considerable range in size has been noted above. Some specimens are more reddish- than yellowish-brown, but this may result from differences in methods of killing and preparing for mounting. The antemedian lateral



CENTRODERA SPURCA

Figure 12. Male genitalia of *Centrodera spurca*. A. The tubular aedeagus in profile; it consists of two longitudinal sclerites, here shown separated by the inflated pliable connecting membrane (stippled); the dorsal sclerite is on the left and ends in a (bifid) prominence. B. Dorsal view of the apical part of fig. A; the dorsal sclerite with its bifid tip overlies the stippled connecting membrane. C. Dorsal view of the flattened apical third of the tegmen (= parameres; for their normal position in relation to the aedeagus see fig. 17A). D. Dorsal view of the bilobed basal third of the aedeagus, i.e., the upper right part of fig. A.

dot on each elytron varies from a maximum diameter of 1 mm. to the tiniest observable spot, and contrary to R. Hopping's statement (1937, p. 11) is completely lacking in about ten per cent of the beetles studied; it varies also from black to a pale brown. R. Hopping's record (1921, second page) of a series of *Pachyta spurca* showing "much variation in maculation" surely resulted from a lapse of memory as to the genus and species on the part of F. E. Blaisdell, who recorded the minutes of the meeting.

The apex of the fifth abdominal sternite varies from rather evenly rounded to broadly emarginate. It may be narrowly or weakly margined, but is usually strongly so, especially in the female, in which the margin tends to be broader and less regular than in the male (fig. 5). Of the 1061

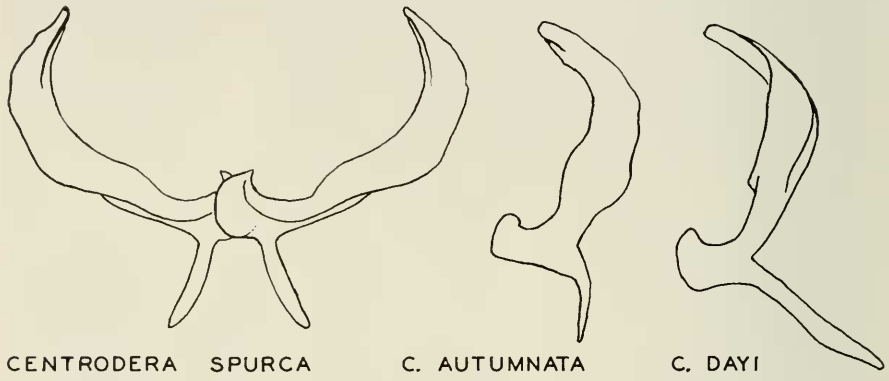


Figure 13. Armature of the intromittent organ of the male genitalia of *Centrodera spurca*, *C. autumnata* and *C. dayi*. For *C. spurca* the paired armatures are shown as they lie partially superimposed when the organ is retracted within the aedeagus; when the organ is everted and inflated during copulation they are on opposite sides of it and separated by a distance about equal to the length of one of them.

specimens of *C. spurca* examined only four, all females, do not show an appreciable margining; they are from Pullman and Rock Island, Washington, and Hat Creek and Meadow Valley, California. All are easily separated from the species with non-margined fifth sternite by the short recurved elytral hairs.

Distribution. There are not many published records for *C. spurca* and its synonym *Typocerus cervinus* Walker; a few of those for Oregon and California may prove to have been based on the new species described in this paper, but I believe over 90 per cent truly refer to *C. spurca*. All records known to me are listed here in abbreviated form; most of the full references may be found in the Leng Catalogue and its supplements, though many are in the terminal bibliography of the present article. I have not

used any of these records in my maps and tables unless I have seen the actual specimens.

LeConte, 1857, p. 23, "Or."; p. 63, Steilacoom, Washington Territory (reference is to the type specimen; see explanation in first paragraph following the synonymy of *C. spurca).*

LeConte, 1860—a repetition of the above.

Walker, 1866, p. 332. British Columbia.

Lacordaire, 1869, p. 439. Orégon.

LeConte, 1869, p. 371. Vancouver's Island [and/or] British Columbia.

Gemminger and Harold, 1872, p. 2859. "California. Vancouv. Ins."

Leng, 1890, p. 98. "Cal., Vanc., Nev."

Fall, 1901, p. 148. Echo Mountain, Los Angeles County, California.

Currie, 1904, p. 28. Kaslo, British Columbia.

Harvey, 1907, p. 4. Victoria, British Columbia.

Wright and Coolidge, 1908, p. 68. Towle, Placer County, California, in June and July.

Aurivillius, 1912, p. 188. "Californien, Nevada, Vancouver-insel."

Casey, 1913, p. 217. ". . . species of the true Pacific Coast fauna."

Woodworth, 1913, p. 228. California (as *Pachyta spurcata* [*sic!*] LeConte).

Gibson, 1917, p. 150. "Swanlake, B. C." (This is Swan Lake, a few miles north of Vernon, British Columbia.)

Garnett, 1918, p. 212. ". . . taken by Fall at Echo Mt., Southern California. Found by Van Dyke at Santa Monica."

Leng, 1920, p. 271. "Nev.–Vanc. So. Cal."

Baumberger, 1921?. St. Helena, Napa County, California. (Date of publication uncertain; page not numbered.)

Hardy, 1926A, p. C28. Victoria, Sidney, Shawnigan, Duncan, British Columbia. British Columbia to California.

Hardy, 1926B, p. 5. (As above.)

Essig, 1926, p. 452. California, Nevada, Oregon, Washington, and British Columbia.

Harvey, 1926, p. 5. (A republication of his 1907 list.)

Canova, 1936, p. 129. Corvallis, Alsea, Junction City, Minam National Forest 20 miles NW. of Bly; all in Oregon.

Doane *et al.,* 1936, pp. 176–177. ". . . throughout the Pacific Coast."

Saalas, 1936, p. 73. "Nordamerika."

Hopping, 1937, p. 11. British Columbia, Idaho and California. ". . . probably occurs in Oregon and Washington. Nevada is mentioned in the literature."

Moore, 1937, p. 88. ". . . San Diego in April and July . . . Warner's Spring in July." (California.)

Hatch, 1939, p. 29. Eastern and western Washington.

Hardy, 1942, p. 10. 3.5 miles N. of Victoria, British Columbia.

L. E. Ricksecker, then of Santa Rosa, California, offered *C. spurca* for sale in his "Price list of Coleoptera of the Pacific Coast, No. 15. January 1, 1897," and probably in earlier lists, though I have not seen them. If he obtained his specimens at his ranch "Sylvania," near what is now Camp Meeker, Sonoma County, he probably had representatives of both true *C. spurca* and one of the species here described as new.

As known to me from actual specimens, *C. spurca* occurs across southern British Columbia except for the mainland west of the coast mountains, from southern Vancouver Island (Ucluelet–Nanaimo–Victoria) to the East Kootenays (Creston), with the most northerly record at Salmon Arm, lat. 50° 41′ N., long. 119° 18′ W.; thence through Washington, northern and mid-western Idaho and adjacent Oregon, Oregon just east of the coast range to San Diego via the coast of California, and to the Greenhorn mountains of Kern County via the Cascades and Sierra Nevada, with a few records for western Nevada. The species must occur in northwestern Montana; a single specimen labeled Salt Lake City, Utah, has been seen. Except that there are no records of *C. spurca* from the British Columbia mainland west of the coast mountains, its distribution is remarkably like that of another cerambycid, *Ergates s. spiculatus* (LeConte); see the map, fig. 8, in Linsley's 1962 paper.

In California, *C. spurca* is known from the following counties, listed in north-south sequence, first for the coast and adjacent mountain areas west of the Central Valley: Del Norte, Humboldt, Trinity, Mendocino, Sonoma, Lake, Marin, Contra Costa, Alameda, San Mateo, Santa Clara, Santa Cruz, Monterey, San Luis Obispo, Ventura, Los Angeles, San Bernardino, Riverside, San Diego. For the Cascades and Sierra Nevada, Siskiyou, Modoc, Shasta, Lassen, Plumas, Tehama, Butte, Nevada, Placer, Eldorado, Alpine, Calaveras, Tuolumne, Mariposa, Mono, Madera, Fresno, Tulare, Inyo, and Kern. As is obvious from the map (fig. 14) the species should be looked for in the Sierra Juárez and Sierra San Pedro Mártir of Baja California, México.

In the coastal region of California *C. spurca* has been taken from about 700 feet above sea level at Carmel, Monterey County, to 5800 feet near the top of Junipero Serra peak, the highest point in the Santa Lucia mountains of the same county, and some 40 miles southeast of Monterey. In Mill Valley, Marin County, it occurs down to an elevation of not more than 100 feet above sea level, while in southern California it has been taken at Lake Arrowhead, San Bernardino County, at 5100 feet. In the southern Cascades there are records from about 2280 feet at Dunsmuir, Siskiyou County, to 3200 feet at Hat Creek, Shasta County, 4450 feet at Alturas,

Modoc County, and about 6700 feet at Summit Lake in Lassen Volcanic National Park. In the Sierra Nevada the lowest station seems to be Quincy, Plumas County at 3400 feet, and Twain Harte, Tuolumne County at 3600;

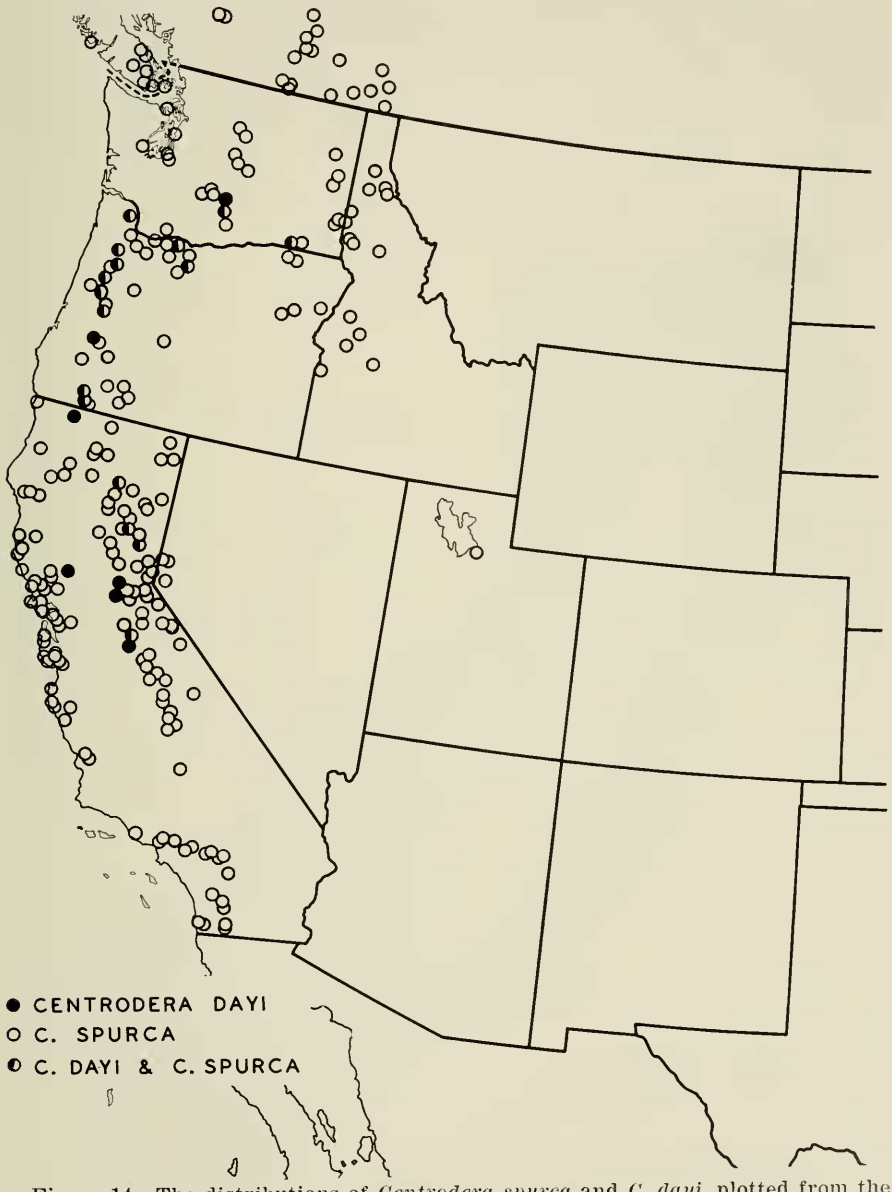


Figure 14. The distributions of *Centrodera spurca* and *C. dayi*, plotted from the locality labels of specimens seen during this study; no records from the literature have been mapped unless represented by specimens. Note that the two species have been taken at the same places in sixteen cases.

thence to 7000 feet at Huntington Lake, Fresno County, and to between 8000 and 11,000 feet near Glacier Lodge, Big Pine Creek, Inyo County, on the east slope of the Sierra Nevada.

Centrodera spurca has not been reported from the Rocky Mountains to my knowledge; it is not in Mank's 1934 Glacier Park list. Neither is it in the Utah list (Knowlton and Wood, 1950), but there is a female specimen in the Ohio State University collection labeled "Salt Lake City, Utah, X.16.1952. R. E. Rodock. R. E. Rodock Collection." October is an amazingly late date for this species.

Figure 15. The known distribution of *Centrodera autumnata*, and the California records for *C. dayi*.

Centrodera autumnata Leech, new species.

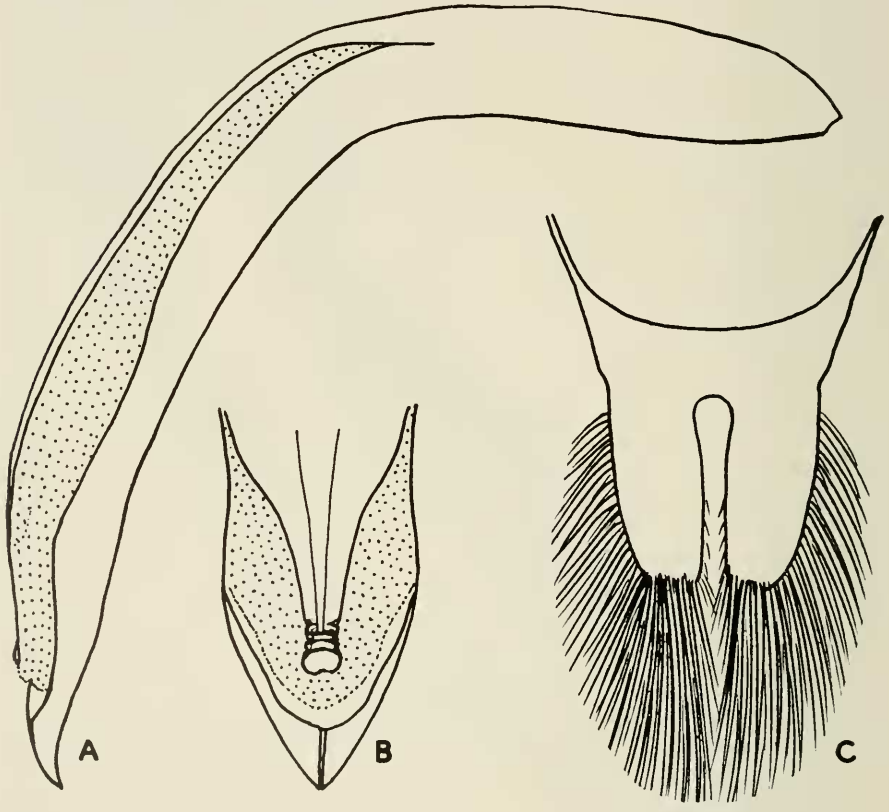
Centrodera spurca LeConte, R. Hopping, 1937. Nat'l. Mus. Canada, bull. no. 85, p. 11 (in part, including the fig. on pl. III).

A species resembling *C. spurca* but averaging smaller, with suberect elytral pubescence, bristly outer antennal segments in the male, non-margined fifth abdominal sternite; appears later in the season, and is restricted to coastal California.

Holotype, male, Mill Valley, Marin County, California, 16.VIII.49, at light (Hugh B. Leech). In the California Academy of Sciences (Entomology).

Length 18 mm., width at humeri 5.2 mm. *Form* elongate, elytra very gradually tapering from base toward apex. *Color* yellowish-brown above and below; tips of mandibles, eyes, and a small oval sublateral spot showing through from lower surface of each elytron just before middle, black; elytra pale yellowish-brown, darkest at base, pronotum and antennae a little darker than elytra, head reddish-brown, tarsal claws and mandibular attachments rufous. *Head* dull between eyes, otherwise shining; punctures on clypeus irregular in sizes and distribution, those on vertex, occipital area and submental region more regular and denser, each puncture giving rise to a hair; width of vertex between eyes slightly narrower than width of an eye, mid-cranial suture apparent but its course very little depressed. Antennae longer than elytra by length of last two segments, 11th segment one and a half times as long as scape and a little longer than first segment of hind tarsus, scape reaching to beyond hind margin of eye; scape, segments 2 to 4 and basal half of 5 shining, finely punctured, clothed with closely appressed hairs and widely spaced suberect fine sensory hairs; apical half of segment 5 and segments 6 to 11 in their entirety dull, the vestiture dual, consisting of fine decumbent hairs, hard to see, and a dense covering of suberect stiff hairs like the pile of a rug, two-thirds as long as the sensory hairs and projecting at the same angle; the outer segments thus have a bristly appearance as in fig. 8. *Pronotum* moderately coarsely punctate, punctures sparser on preapical and prebasal transverse grooves, coarsest at sides of disk where some punctures are contiguous, integument there subrugose; vestiture sparse, of fine erect hairs, especially at sides basally, and of shorter decumbent hairs which are less obvious; lateral tubercles blunt, slightly antemedian, prothoracic width at (and including) tubercles 95 per cent of width at base and about one-third greater than width at apex. *Elytra* widest at humeri, gradually tapering to apices, fastest in apical sixth; width at humeri is to length as 11 is to 26; punctures coarse and dense basally except on humeri, discal punctures separated from one another by about one-half their own widths, becoming progressively smaller and shallower toward elytral apices, densest just behind humeri; apices

vaguely truncate, without tooth at sutural angle. The hairs arising from elytral punctures short, standing out at an angle, especially in discal region; elytral surface more opaque than in *C. spurca*, golden subsurface reflections less evident. Front, middle, and hind tarsi progressively narrower and more elongate, first three segments of front tarsus seven-tenths as long as front tibia; first segment of hind tarsus long, narrow, parallel-sided, very slightly broadened apically (fig. 10), one-third as long as hind tibia; second segment of hind tarsus rounded on top, almost half as long as first. Hind femur reaching slightly beyond apical seventh of elytra, with a series of sparse long hairs along hind margin, from tip of trochanter nearly to apex, hairs from half to three-quarters as long as femur is wide and inclined somewhat toward abdomen. *Male genitalia* (see fig. 16, and the general dis-



C. AUTUMNATA

Figure 16. Male genitalia of *Centrodera autumnata*. A. Profile of the tubular aedeagus, the upper (on the left side) and lower sclerites here shown separated by the pliable connecting membrane, stippled. B. Dorsal view of the apical part of the aedeagus. C. Dorsal view of the parameres.

cussion of the organs in the early part of this paper). Essentially as in *C. spurca,* but differing as follows. Median line of apical two-thirds of dorsal side of aedeagus much less strongly or not at all differentiated in color, ending in a less prominent knob which is not bifid apically, but with transverse rugae on the depressed neck just before apical bulb. "Floor" of median area of tegmen deeper than in *C. spurca,* hairs of parameres shorter and paler in color, inner face of paramere with only about 25 hairs. Armatures of intromittent organ as in fig. 13; it is possible that their apparent difference in shape from those of *C. spurca* may be due in part to some slight difference in the angle of viewing.

Allotype, female, Mill Valley, Marin County, California, 13.VIII.1949, at light (H. B. Leech) [CAS]. Length 17 mm., width at humeri 5 mm. Similar to the male but more robust (as in fig. 11), elytra not tapering gradually from base to apex but a little wider at apical quarter than at base, apices rounded. Antennae shorter than body, reaching to apical quarter of elytra (equivalent to third abdominal sternite), segment 11 seven-tenths as long as scape; hairs on segments 6 to 11 and on apical half of 5 appressed, except for the scattered suberect sensory hairs. Fifth abdominal sternite lightly margined at sides near base; intercoxal process of first abdominal sternite a little blunter apically than in holotype.

Paratypes, all from California. Marin County: 55♂♂, 7♀♀ topotypes, taken by members of my family or myself at our former home at 427 Rose Avenue, Mill Valley (elevation 600 feet), nearly all attracted to lights and collected on the windows of the house, 1948–1956; 1♂ in May, 5♂♂ in July, 40♂♂ and 5♀♀ in August, 11♂♂ and 2♀♀ in September [CAS]. Also the following from other parts of Mill Valley; 1♂ 23.VI.1925, 4♂♂ 22.VIII.1925, 1♂ 8.VIII.1925, 1♂ 3.IX.1924 (E. P. Van Duzee) [CAS]; 1♂ 19.VII.1954, 1♂, 2♀♀ 17.VIII.1950 (E. S. Ross) [CAS]; 1♂ 7.VII.1959, 1♀ 16.VII.1959, 1♂, 1♀ VIII.1959 (J. Sedlacek) [J. Sedlacek]; 1♀ 23.IX.1950 (F. X. Williams) [CAS]; 1♀ 3.IX.1950 (D. Kelley) [CAS]; 7♂♂ 7.VIII.1953, 5♂♂, 1♀ 10.VIII.1953, 1♂ 23.VIII.1953, 8♂♂ 25.VIII.1953, 2♂♂ 1.IX.1953, 2♂♂ 9.IX.1953, 1♂ 9.IX.1954, 1♂ 3.VIII.1955, 3♂♂ 16.VIII.1955, 1♂ 23.VIII.1955 (all by H. L. Mathis, those for 1955 labeled "Light Trap Collecting") [UCD]; 1♂ 7.VII.1961, Bootjack Camp, south slope of Mt. Tamalpais (H. B. Leech) [CAS]. Also the following from other places in Marin County; Novato, 1♂, 1♀ 16.VIII. 1954, at light (H. B. Leech) [CAS. Observed in copulation on August 17]; 1♂ 6.IX.1948, 1♂ 18.VIII.1954 (E. L. Kessel) [CAS]; Umdelelannyoni, Novato, 2♂♂ 5.VII.1952, 2♂♂ 26.VII.1952 (E. L. Kessel) [CAS]; Lagunitas, 1♂ 30.VII.1921 (F. E. Blaisdell) [CAS]; Lansdale, 1♂ 30.VIII.1914 (R. Hopping collection. The pin carries a pink label marked "Pl." and the specimen is the one used by George R. Hopping in making his drawing for

fig. 4, pl. III of R. Hopping's 1937 paper on the Lepturini) [CAS]; Toll House, 2♂♂, 2♀♀ 5.VIII.1949 (Alice Edwards, J. G. Edwards) [JGE]; Woodacre, 1♂ 27.VII.1955, 3♂♂ 3.VIII.1955, 1♂ 16.VIII.1955 (H. L. Mathis) [UCD]; Fairfax, 1♂ 25.VIII.1953 (H. L. Mathis) [UCD]; Strawberry Point, 1♂ 6.VIII.1953 (H. L. Mathis) [UCD]; San Anselmo, 1♂ 24.VII.1940 [CAS]; Ross, 1♂ 3.VIII.1955, 1♂ 16.VIII.1955 (H. L. Mathis) [UCD]. Humboldt County: Dyerville, 1♂ 18.VIII.1951 (R. W. Dawson) [RWD]. Sonoma County: Rio Nido, 1♂ 31.VII.1946 (D. Giuliani) [DG]; Guerneville, 1♂ 11.VIII.1948 (D. Giuliani) [DG]; Stewarts Pt., 1♂ VI. 1942, 1♂ VII.43 [CIS]. San Mateo County: La Honda, 1♂ 14.VIII.1925 (U. S. Grant IV) [SDNHM]. Santa Clara County: Cupertino, 1♂ 20.VI.1939 (K. S. Hagen) [CIS]; Los Gatos, 1♂ 16.VIII.1954 (Sr. Mary Baptista) [USF]; Alum Rock Park, 1♂ 17.VII.1949 (S. R. Piazza) [SRP]; San Jose, 1♂ 17.VII.1931, 1♂ 22.VII.1931 [CIS]. Santa Cruz County: Big Basin Redwood State Park, 1♂ 1.IX.1953 (P. H. Arnaud, Jr.) [CAS]; Big Basin, 1♂ 10.VIII.1933, 2♂♂ 12.VIII.1933 (W. H. Lange) [UCD], 1♂ 17.VII.1940 (B. Brookman) [UI]; Boulder Creek, 3♂♂ 6.VIII.1941 (J. W. Tilden) [SJSC], 1♂ 20.VII.1949 (W. E. Hazeltine) [CAS], 1♀ 21.VIII.1935 (B. E. White) [CAS]; Brookdale Lodge, 1♂ 18.VIII.1940 (K. Frick) [CIS]; Ben Lomond, 4♂♂, 2♀♀ 30.VII.1959 (D. Rentz) [DR], 1♂ 3.VIII.1959 (C. Wemmer) [CAS], 4♂♂ 31.VIII.1962 (C. D. MacNeill) [CAS], 1♂ "1918" (Mary Knowles; R. Hopping Collection) [CAS]; Mount Hermon, 1♀ 16.VIII.1949 (W. E. Hazeltine) [CAS]; Santa Cruz hills south of Felton, 3♂♂ 27.VII.1961 (G. Follin) [CAS]; Santa Cruz, 1♂ VIII.37 [CIS], 1♂ 2.VII.1941, 1♂ 7.VII.1941, 1♂ 10.VII.1941, 2♂♂ 12.VII.1941, 1♂ 17.VII.1941 (J. W. Tilden) [SJSC]; Highland District, 2♀♀ 2.IX.1956 (S. M. Fidel) [UCD]; "Santa Cruz Co.", 1♀ VIII. 1916, 2♂♂ VII.1917 (E. R. Leach) [CAS]. Montery County: Junipero Serra Peak, Santa Lucia Mountains, on peak ca. 5800 ft. elev., at light, 4♂♂ 8.VIII.1956 (H. B. Leech) [CAS]. Santa Barbara County: Carpinteria, 1♀ 1.IX.1935 (B. E. White) [CAS]. San Bernardino County: Barton Flats, 2♂♂ 20.VIII.1936, 1♂ 21.VIII.1936 [CAS]. Riverside County: Idyllwild, 1♂ VIII.1946 (C. Harnage) [UCD]. San Diego County: Newton, 1♂ 14.VII.1949 (D. J. & J. N. Knull) [JNK]; Laguna, 1♂ 22.VII.1934 (C. C. Seard) [SDNHM].

Additional specimens studied but not designated as paratypes are the following: Marin County: Mill Valley, 1♂ 28.VI.1959 "at light, first of season" (H. B. Leech), 3♂♂ 18.VIII.1950 (H. B. Leech) [CAS]; "Redw. C. Ft. Hills" [= Redwood Canyon foothills near Muir Woods?], 2♂♂ 18.VIII.1946, 1♂ 21.VIII.1946 (D. Giuliani) [DG]. Santa Cruz County: Ben Lomond, 1♀ 3.VI.1946, 1♂ 8.VI.1946 (W. Lee) [CAS]. Santa Barbara County: Santa Barbara, 1♀ (F. E. Winters) [CAS].

In addition to those being returned to their owners, paratypes will be deposited in the following institutions: the U. S. National Museum, Washington, D. C.; the Canadian National Collection, Ottawa, Ontario; the British Museum (Nat. Hist.), London; the University of British Columbia, Vancouver; the University of Washington, Seattle; Oregon State University, Corvallis.

Variation. The paratype males vary in size from a length of 14 mm. and a width at the humeri of 4 mm., to a length of 21 mm. and width of 6 mm., with averages of 18.2 mm. and 5 mm. respectively; paratype females from a length of 16 mm. and width of 4.5 mm. to 22.5 mm. and 6.75 mm., with averages of 18.8 mm. and 5.5 mm. There is an appreciable variation in color, from pale yellowish-brown to distinctly reddish-brown. It is hard to tell how much of the variation is natural because all living examples I have seen have been yellowish-brown; I suspect the darker color of some dried specimens results in part from different methods of killing and preserving.

The clypeus may be somewhat flattened, smooth, and impunctate in front as is the labrum, or it may be punctate right up to its front edge. The apex of the scutellum varies from broadly rounded to pointed, and is occasionally slightly irregular but not emarginate. The elytral apices vary from distinctly truncate to rounded, or even incised. Only a single specimen has been seen in which the semi-erect hairs of the basal half of the elytra are so abraded as to give difficulty in the key. The much finer erect hairs of the pronotum are often matted down or worn off, except behind the lateral tubercles; these latter vary from softly rounded protuberances to almost spinous processes. The intercoxal process of the first abdominal sternite of some females is as sharply pointed as in the male, in others it is blunter or even rounded apically. None of these variations is correlated with distribution.

Remarks. Males of *C. autumnata* resemble those of *C. spurca* fairly closely in form but average smaller and are commonest later in the season; both have antennae surpassing the elytral apices by the length of the last two segments. *Centrodera autumnata* is easily recognized by the suberect elytral pubescence, non-margined fifth abdominal sternite, long narrow hind tarsi, fuzzy-appearing outer antennal segments (see figs. 8, 10). These same characters, except the last, will also separate females of *C. autumnata* from those of *C. spurca*.

Males of *C. autumnata* may be separated from those of *C. dayi* by their more elongate and less triangular elytra, longer antennae with the eleventh segment longer than the first segment of the hind tarsus, and their narrower and more elongate tarsi, especially the front tarsi (figs. 9, 11, 18). Females

of *C. autumnata* are recognized by their narrower and more elongate hind tarsi, with the second segment rounded rather than flattened on top.

Distribution. *Centrodera autumnata* is known only from the coastal area of California, from Dyerville, Humboldt County to San Diego County (fig. 15). It occurs from virtually sea level at Mill Valley, Marin County, to 5800 feet in the Santa Lucia Mountains of Monterey County, but is unknown from the Monterey coast where *C. spurca* is not rare. Although its distribution is entirely within the southwestern edge of that of *C. spurca* (figs. 14, 15) and they have nine localities from Sonoma County to Riverside County in common[3], they must have very different ecological requirements. For instance, at Mill Valley both species are remarkably common, especially *C. autumnata;* yet just across San Francisco Bay in Berkeley and the Oakland hills, where *C. spurca* is fairly common, there are no records for *C. autumnata.* A little south of the bay, however, it occurs further east than the Oakland hills (fig. 15).

The gap between the Humboldt County and Sonoma County localities is almost certainly because there has been little collecting at light in the late summer; but similar gaps south of Monterey County are likely to indicate extensive areas of unsuitable habitats. The species should be looked for in the northern mountains of Baja California, México. The finding of *C. dayi* at Rumsey, Yolo County, some 50 miles due east of the Sonoma County records for *C. autumnata,* suggests that their distributions may over lap in the Eel River country.

Centrodera dayi Leech, new species.

? *Centrodera hirsuta* R. Hopping (Ms., *nomen nudum)*, 1939. *In* Hatch, Prelim. list Coleopt. Wash., p. 29.

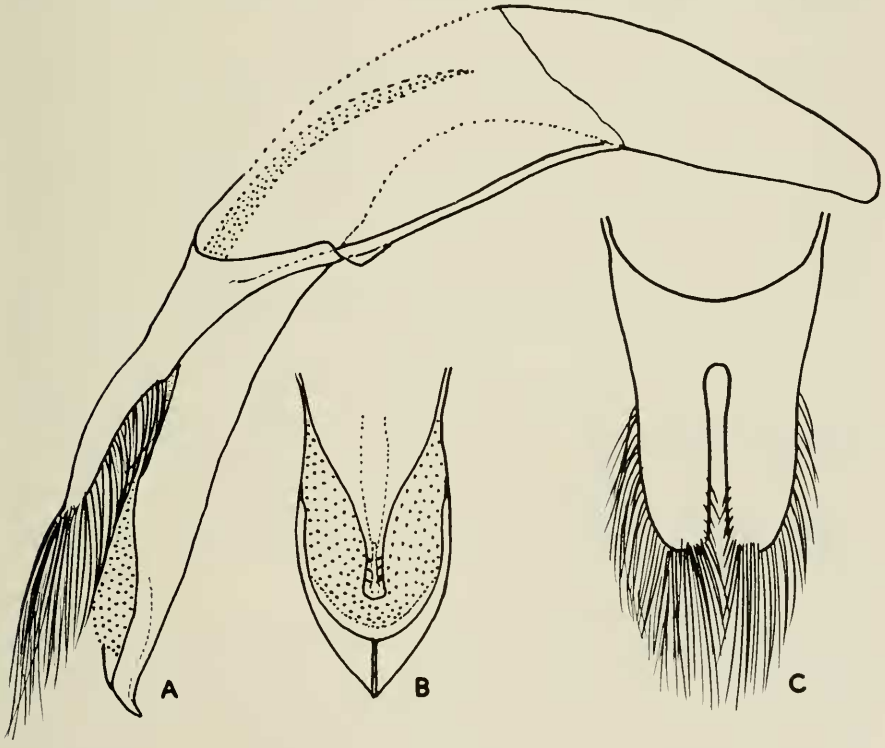
A species resembling *C. spurca* but which has shorter antennae in the male, shorter front tarsi, suberect elytral vestiture, shorter elytra which are distinctly cuneate in most males, and coarser elytral punctation especially in the apical half. Known from south central Washington to the foothills of the Sierra Nevada in central California.

Holotype, male, Scott River at Klamath River, Siskiyou County, California, I.VIII.1949, at light (W. C. Day). In the California Academy of Sciences (Entomology).

Length 19.2 mm., width at humeri 5.7 mm. *Form* moderately elongate (as in fig. 11), elytra tapering regularly from humeri to near apices. *Color* brown, eyes, tips of mandibles and antemedian lateral spot (showing through from underside of each elytron), black; head, thorax, legs, basal four segments of antennae and basal third of elytra reddish-brown, ab-

3. *Centrodera autumnata* flies later in the season, when fewer collectors are in the field, and the two may actually have more localities in common than museum records indicate.

domen, outer antennal segments and apical two-thirds of elytra yellowish-brown. *Head* shining; punctures of irregular sizes dorsally, less coarse and more evenly distributed on submental area, each giving rise to a hair; width between eyes slightly less than width of an eye; mid-cranial suture clearly, evenly impressed. Antennae reaching to just beyond elytral apices, 11th segment a little shorter than scape but equal in length to first segment of hind tarsus, scape reaching to beyond hind margin of eye; scape, segments 2 to 4 and basal two-thirds of 5 shining, finely punctured, clothed with appressed hairs, and some widely spaced suberect fine sensory hairs; apical third of segment 5 and segments 6 to 11 dull, with a vestiture of nearly decumbent fine hairs from which the sparse suberect sensory hairs stand out clearly as in fig. 7, the whole having a slightly velvety appearance; 11th segment tapering from apical three-fifths to tip. *Pronotum* strongly inflated between preapical and prebasal transverse impressions, closely and



C. DAYI

Figure 17. Male genitalia of *Centrodera dayi*. A. Profile of the tubular aedeagus, with the tegmen in its normal position over it, the parameres covering the apical portion of the dorsal sclerite. B. Apical part of the aedeagus, dorsal view. C. Parameres, dorsal view.

rather evenly punctate, punctures about comparable in size to those at middle of elytra; vestiture of fine mostly appressed hairs, one from each puncture; blunted lateral tubercles slightly antemedian, width of prothorax across tubercles a trifle wider than at base, apex five-sevenths width of base. Apex of scutellum rounded. *Elytra* widest at humeri, regularly tapering to apical seven-ninths where they are a little less than nine-fourteenths width at base, then more rapidly to apices; width at humeri about six-fourteenths the elytral length; punctures coarse basally, fairly regularly in oblique series of four between traces of costae following courses of the longitudinal tracheae, gradually smaller and shallower from base to apex, those near apex comparable to discal pronotal punctures but shallower; apices subtruncate, without tooth at sutural angle. Each elytral puncture giving rise to a hair, of which those on discal area stand out at an angle, suberect, those at sides and toward apices more nearly decumbent. Front and middle tarsi much broader than hind tarsi (as in figs. 9, 10), front pair notably broad; first three segments of front tarsus six-tenths as long as front tibia; first segment of hind tarsus one-third length of hind tibia, very gradually widening from base to apex, appreciably broadened apically, second segment flattened dorsally, a little less than two-fifths length of first. Hind femur with a row of sparse hairs along hind margin, from tip of trochanter nearly to apex, hairs less than half as long as femur is wide. *Male genitalia* as in figs. 13, 17; for general description see *C. spurca*.

Allotype, female, same data as for holotype but collected on August 7; in California Academy of Sciences (Entomology). Length 17.5 mm., width 5.7 mm. Generally similar to male but more robust (as in fig. 11). Head and thorax tinged with piceous, elytra more uniformly yellowish-brown, more parallel-sided, less tapering than in male. Antennae reaching to just beyond apical two-thirds of elytra (*i.e.* not quite to apex of second abdominal sternite); segment 11 is to scape as 2 is to 2.75; vestiture of segments 6 to 11 and apical half of 5 appressed, except for scattered suberect sensory hairs. Fifth abdominal sternite exceedingly narrowly margined apically; elytral apices rounded.

Paratypes. WASHINGTON: Yakima County; Yakima, 1♂ 10.VIII.1931 (A. R. Rolfs. R. Hopping collection) [CAS], 1♀ 10.VII.1936, elevation 1025 feet (R. W. Every) [CIS]; Selah, 1♀ (Rufus Kiser) [UW]. Walla Walla County; Walla Walla, 1♂ 30.VII.1952 (M. C. Lane) [JNK], 1♂ 30.VII.1947 (W. C. Cook) [JS]; Kooskooskie, 1♂ 1.VIII.1932, 1♂ 21.VIII.1932 (M. C. Lane) [USNM]. OREGON: Columbia County; St. Helens, 1♂ 21.VII.1936, at light (K. Gray, J. Schuh) [OSU]. Hood River County; Mid Col. Expt. Sta., Hood River, 2♂♂ 30.VII.1957, 1♀ 3.VIII.1957, 1♂ 23.VIII.1957 (Clive D. Jorgensen) [OSU], 1♀ 3.VIII.1957 (Clive D. Jorgensen) [RBH]; Hood River, 1♀ 18.VIII.1954, at light (Paul

O. Ritcher) [AHH]. SHERMAN COUNTY; Pine Grove Dist., Maupin, 1♂ May–June '52 [UW]. YAMHILL COUNTY; McMinnville, 1♂ 24.VII.1944, 1♀ 1.VIII.1949, 1♀ 4.VIII.1952 (K. M. & D. M. Fender) [UW]. MARION COUNTY; Salem, 1♂, 1♀ 31.VII.1959, 3♂♂, 3♀♀ 31.VIII.1959, Blk. Lt. Trap (Harold Foster) [OSDA]. BENTON COUNTY; Corvallis, 1♀ 7.VII.1931 (N. P. Larson), 1♀ 8.VIII.1952 (Paul O. Ritcher) [OSU], 1♀ 16.VIII.1941 (K. M. & D. M. Fender) [UW], 1♀ 8.VIII.1925 [USNM, *ex* Brooklyn Museum Collection]; Monroe, 1♂ 6.VII.1931 (N. P. Larson) [OSU], 1♀ 23.VII.1931, in moth trap (N. P. Larson) [OSU], 1♂ 30.VII.1931 (Joe Schuh) [JS]. LANE COUNTY; Goshen, 1♂ VIII.1941 (R. Fauts [*sic!*]) [BM]. DOUGLAS COUNTY; Sutherlin, 1♀ 30.VII.1944 (Elwood Mabry) [GHN]. JACKSON COUNTY; Medford, 1♀ 3.VIII.1946 (C. Fitch) [UCD], 5♂♂, 3♀♀ 11.VIII.1944, 2♂♂, 1♀ 12.VIII.1944, 1♂, 3♀♀ 20.VIII.1944, 3♀♀ 29.VIII.1944, all in light trap (C. Fitch) [UCD]; Talent, 1♂, 1♀ 24.VII.1938, In c. moth bait pan (L.G. Gentner) [LGG, UCD], 1♀ 15.VIII. 1940 (L. G. Gentner) [UCD]; Green Springs, 1♂, 1♀ 27.VIII.1961 (J. S. Buckett) [UCD]. CALIFORNIA: same data as holotype, 2♂♂, 1♀ [CAS], same data but August 10, 2♂♂ [CAS]. SISKIYOU COUNTY; Scott River, 1♀ 10.VIII.1949, collected at light (W. C. Day) [CAS]. YOLO COUNTY; Rumsey, 1♀ 5.VIII.1955 (E. A. Kurtz) [UCD]. SHASTA COUNTY; Hat Creek, 1♀ 26.VII.1951, 1♀ 25.VII.1952 (G. F. Pronin) [CAS], 1♀ 5. VIII.1942, Flight at light [CIS], 1♂, 1♀ 11.VIII.1956, 2♀♀ 12.VIII. 1956, 1♀ 17.VIII.1956, 1♀ 18.VIII.1956, 1♀ 19.VIII.1956 (H. Ruckes, Jr.) [CIS], 1♀ 28.VII.1957 [CIS]. PLUMAS COUNTY; 4 miles W. of Quincy, 1♀ 26.VI.1949 (W. R. Schreader) [UCD], 1♀ 16.VII.1949 (F. Morishita) [CIS]; Johnsville, 1♂ 30.VII.1960, 3♂♂, 1♀ 9.VIII.1961 (J. S. Buckett) [UCD]. ELDORADO COUNTY; Georgetown [erroneously stated to be Placer County on the label] 1♀ 29.VIII.1948 [DG]. TUOLUMNE COUNTY; Twain Harte, 1♀ 9.VIII.1958 (D. C. Rentz) [DR], 1♂ 20.VIII.1960 (M. Lundgren) [ML]; near Groveland, 1♀ 27.VII.1954 [CIS].

The following additional specimens were studied, but are too damaged to be made paratypes: 1 topotypic male, 10.VIII.1949 [CAS]; Mid Col. Expt. Sta., Hood River, Oregon, 1♂ 21.VIII.1957; Goshen, Lane County, Oregon, 1♂ VIII.1941 (R. Fauts [*sic!*] [BM]; Medford, Oregon, 1♀ 11. VIII.1944, Light trap (C. Fitch) [UCD]; Minam N. F. [Oregon], 1♀ 5.VIII.1914, (Or. Ex. Sta. No. 1458) [OSU]; Placerville, Eldorado County, California, 1♀ 29.VIII.1948 [DG].

In addition to those returned to their owners, paratypes will be deposited in the Canadian National Collection, Ottawa, and the British Museum (Natural History), London.

VARIATION. Paratype males vary in length from 14.5 to 19.4 mm., and in width at the humeri from 4.00 to 5.6 mm., with averages of 17.3 and 5.2

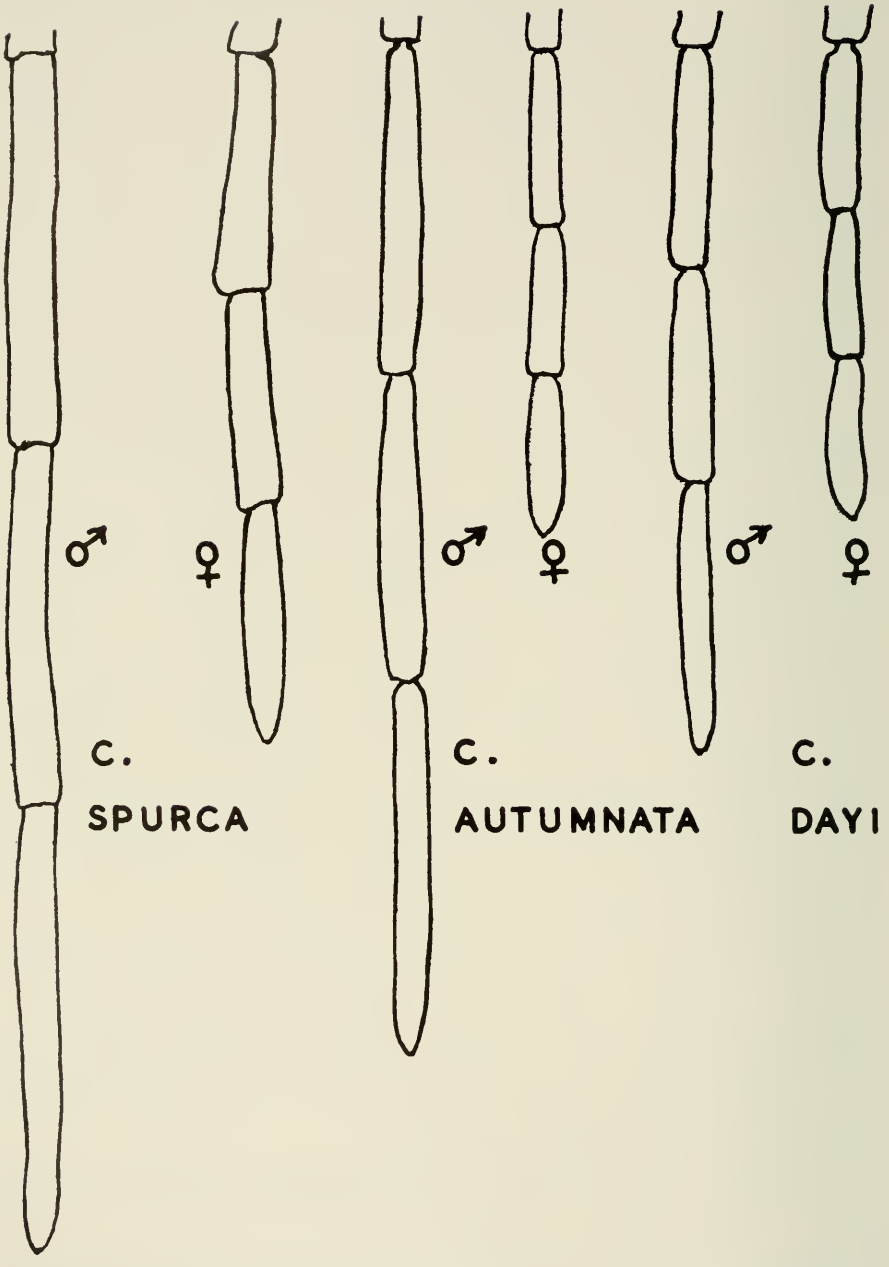


Figure 18. Last three antennal segments of males and females of *Centrodera spurca*, *C. autumnata* and *C. dayi*; vestiture omitted.

mm. respectively; paratype females vary in length from 13.4 to 20.5 mm., and in width from 4.7 to 6.5 mm., with averages of 18.1 and 5.5 mm. respectively. The elytral color varies from a pale yellowish-brown to a decidedly reddish-brown. The apex of the scutellum is rounded in all specimens seen, though it varies a little in width.

The outer antennal segments of the females vary in length more than in related species. Most specimens have segments 10 and 11 as in fig. 18, but 11 may be shorter or longer than 10, and in some cases they are long enough to be confused with the same segments of the male. The fifth abdominal sternite varies from very narrowly and obscurely margined apically to completely unmargined, in the female; it is unmargined in the male.

Remarks. In a mixed series of the three species, males of *C. dayi* can usually be picked out because of their short and somewhat triangular elytra; females resemble those of *C. autumnata* but are more heavy shouldered and straight sided (fig. 11). The sexes are harder to separate in *C. dayi* than in the other two species; males have more strongly tapering elytra, longer antennae, and less smoothly vestitured outer antennal segments; antennal segments 10 and 11 are usually appreciably longer in the male.

Centrodera dayi may be separated from *C. spurca* by its short body form (fig. 11), suberect elytral pubescence, much coarser punctation in the apical half of the elytra, short broad foretarsal segments (fig. 9), shorter antennae, and the bristling vestiture of the outer antennal segments in the male. In males of *C. dayi* antennal segment 11 is barely or not as long as the scape; in *C. spurca* and *C. autumnata* it is as long as or longer than the scape and segment two combined.

The male of *C. dayi* is distinguished from that of *C. autumnata* by its more strongly tapered elytra (fig. 11), much broader fore tarsi (fig. 9), and short antennae which barely reach beyond the elytral apices. Females differ from those of *C. autumnata* by their stouter build, straight sided elytra (distinctly narrowed behind the humeri then widened again in *C. autumnata)*, and shorter and broader fore tarsi (figs. 9, 11). Both sexes of *C. dayi* have shorter hairs along the hind margin of the hind femur, starting at the tip of the trochanter, than does *C. autumnata* (specimens must be clean to show this properly), and a more evenly inflated pronotal disk.

Distribution. In general, one may say that *C. dayi* follows the Cascade mountains from Washington to California (fig. 14), where it goes due south at least to Yolo County on the west side of the Sacramento Valley (a single record for Rumsey, elevation 300 feet; see fig. 15). Via the end of the Cascades in the Mt. Lassen region it reaches the Sierra Nevada and thence the western foothills, at elevations of 2000 to 4000 feet, to just west of Yosemite National Park.

Its occurrence at Walla Walla, Washington, suggests that it may yet be found in western Idaho. The several localities in and to the northern border of the Willamette Valley of Oregon make one expect it west of the Cascade mountains in Washington, though it is not in the Willapa Bay list of Hatch and Kincaid. More collecting in northwestern California may show its distribution to overlap the northeastern edge of that of *C. autumnata.*

The Wing Venation of Some Species of *Centrodera*

Swaine and R. Hopping gave a detailed drawing of the basal half of the wing of *C. spurca* (1928, pl. XI), and a photograph of the wing of *C. decolorata* (pl. XIII, fig. 19). Saalas studied and figured the wings of rep-

Figure 19. Wing of *Centrodera spurca.*

resentative species of the major categories of Cerambycidae. He remarked (1936, p. 71) that the wing of *C. decolorata* as figured by Swaine and Hopping does not differ in any significant way from that of species of the genus *Rhagium,* and that the short extra branching of Cu_1 they show[4] is probably just an anomaly. On the basis of their figure of part of the wing of *C. spurca,* he refers the species without further explanation to the genus *Evodinus* (p. 73), noting that CuZ is well developed and Cu_1 is 3-branched, as for example in *C. decolorata.*

4. There is still no universally accepted opinion as to the homologies of the wing venation of the Coleoptera. The anal veins of Forbes (1923) and of Swaine and Hopping are the cubitals of Saalas. The wedge-cell of Forbes, significant in *Centrodera,* is the anal cell of Swaine and Hopping, and the Cubitalzelle of Saalas.

An entire wing of *C. spurca* is shown in fig. 19; the wedge-cell is large, and 2nd A_2 goes off just below it (using the venational nomenclature of Forbes, 1923). In *C. decolorata,* however, 2d A_2 goes off from an angle of

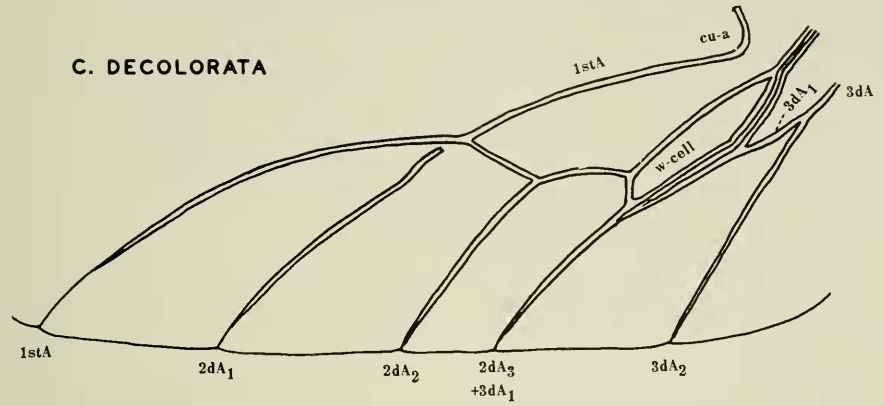


Figure 20. The wedge-cell region of a wing of *Centrodera decolorata.* The venational nomenclature is here according to Forbés, 1923.

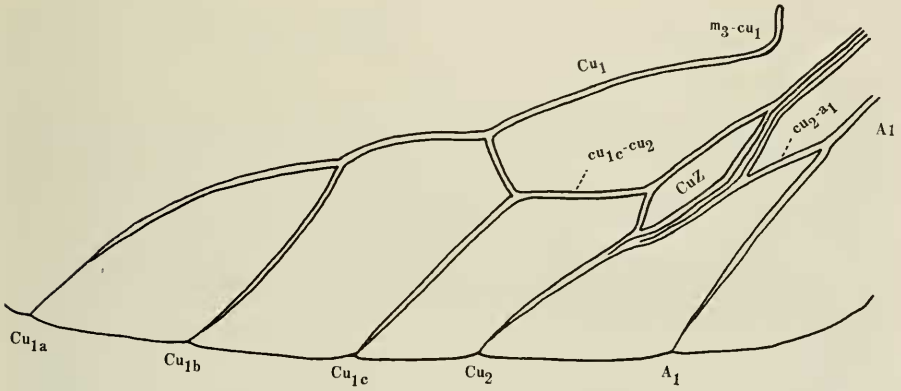


Figure 21. The wedge-cell region of a wing of *Centrodera decolorata.* Venational nomenclature according to Saalas, 1936.

the wedge-cell itself, and this is constant in the eight examples studied; but the branching of the first anal in these same wings is so variable (figs. 20, 21, 22, 23) that three branches cannot be cited as typical. Of the wings examined but not illustrated, one is almost as in fig. 20, two are duplicates of figs. 21 and 22 respectively, while the fourth has a spur as in Swaine and Hopping's illustration (pl. XIII, fig. 19) but the outer branch is bifid as in my fig. 22. Obviously a 3-branched form cannot be considered typical.

The venation of *C. autumnata* is like that of *C. spurca,* but the wedge-cell is smaller; in *C. dayi* it is a little smaller still. In *C. sublineata* LeConte

and *C. nevadica* LeConte, the wedge-cell is absent and 1st A is only 2-branched; but in an undescribed species related to the later, in which 1st A is also 2-branched, there is a very small but clearly defined wedge-cell. In the few specimens of *C. picta* I have checked, there is no wedge-cell, 1st A is 3-branched, but 2d A_2 is not joined to 2d A. In the only wing of *Apatophysis* sp. which I have examined there is no wedge-cell, 1st A is 2-branched, and there is no trace of a cross connection between 1st A and 2d A. These facts seem to present only difficulties to the systematist, but ultimately they may help in finding a key to the puzzle of relationships and generic segregates.

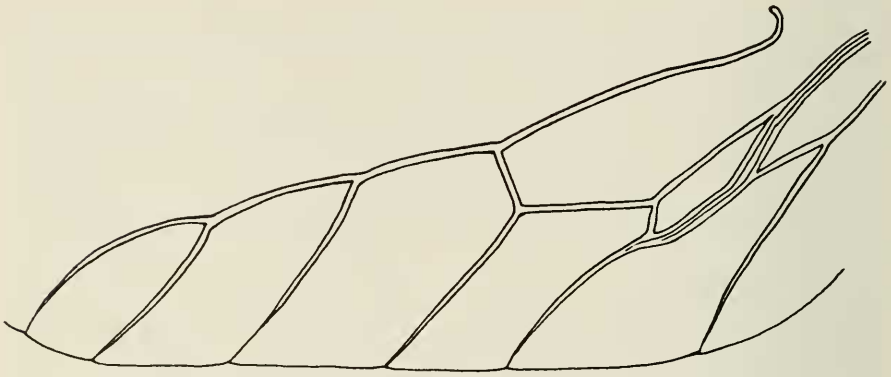


Figure 22. The wedge-cell region of a wing of *Centrodera decolorata.*

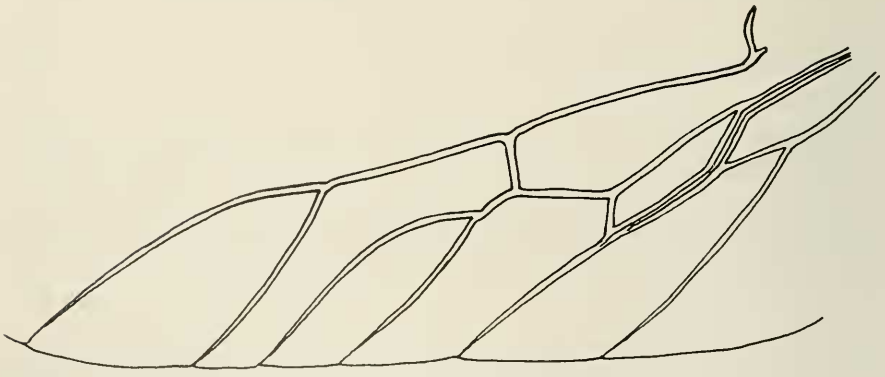


Figure 23. The wedge-cell region of a wing of *Centrodera decolorata.*

The Eggs of the Species of the *Centrodera spurca* Group[5]

Centrodera autumnata. The female mentioned in the paragraphs under the heading "Copulation" later in this paper was put in Bouin's solution, and the abdomen subsequently dissected. It was packed full of large, white eggs, so stuffed in fact that some projected up into the thoracic cavity. All 49 eggs were mature.

The egg: length 2.65 to 3.00 mm., width 0.80 to 0.95 mm. Form elongate ovoid, one end more rapidly narrowed than the other, apices rounded; chorion dull, covered with minute spines which are sparser at apices, not scattered, but arranged in closely spaced longitudinal lines.

Centrodera dayi. A few eggs, dissected from a dried specimen, were rendered turgid by being soaked in a detergent solution. They appear to be inseparable from those of *C. autumnata*, and have the same spinose chorion.

Centrodera spurca. The eggs of this species are readily distinguished from those of *C. autumnata* and *C. dayi* by their surface sculpture.

The egg: length 2.65 to 2.90 mm., width 0.70 to 0.80 mm. Fusiform, nearly paralled-sided, apices rounded or slightly truncated. Chorion dull, smooth, with faint net-like reticulation of regular, minute hexagonal cells; no surface irregularities or spines apparent at X112. Color white.

Figure 24. The larva of *Centrodera spurca*, lateral view.

5. In life the integument of *C. spurca* and *C. autumnata* (I have not seen *C. dayi* alive) is remarkably transparent. The underside of the abdomen is so transparent that in a gravid female the individual eggs are clearly visible, while if the antennae are held against even a moderate light the contents of the basal four or five segments can be seen.

The Larva of *Centrodera spurca*

The larvae before me (see mention of them under the heading "Life History") are from 30 to 34 mm. in length, but only one is fully extended and it may not be mature. Judging by the variation in length of the beetles, it is likely that mature larvae vary from 25 to over 40 mm. in length.

Form elongate, cylindrical, virtually without taper except for the last two abdominal segments (fig. 24); integument shining, slightly wrinkled, sparsely clothed with slender copper-colored hairs. Head yellowish-brown, frons in front of the transverse line reddish-brown, becoming black along frontal margin, mandibles black, their articular areas dark reddish-brown to black; clypeus pale yellowish-brown, reddish at base, labrum reddish-brown, pale apically, maxillae and palpi in part reddish-brown. Thorax and abdomen white, prothorax with narrow yellowish-brown band near front margin, band widening laterally; spine-bearing tumidity on ninth abdominal tergum yellow, spine itself brown (figs. 25, 26); spiracles and legs brown.

Head suborbicular with scattered slender setae, frons flattened and a little depressed; labrum transversely suborbicular, rounded in front, length

Figure 25. Larva of *Centrodera spurca*. Abdominal tip in profile, showing the mammilate tubercle on the tumidity at the apex of tergite 9.

to width as 2 is to 2.5, whole subcircular margin ciliate, most densely anteriorly; clypeus three times as wide as long; mandibles short, thick, blunt, cutting edge oblique with a flat grinding area adjacent, a slight angle present at inner end of cutting edge; antennae conical, hardly protruding beyond sockets, basal membrane large, not retractile. Three indistinct ocelli present, two close together just below level of antenna, one on a level with antenna and at a distance about equal to width of basal membrane of antenna. Anterior edge of hypostome broadly curved, ventral mouthparts extended; apical (third) segment of labial palpus broader and a trifle longer than that of maxillary palpus, maxillary lobe (lacinia) a little broader than first segment of maxillary palpus, as long as first and second segments combined, beset with strong golden setae apically and internally; mentum quadrate, as broad as a stipes; gula well defined, slightly protuberant, almost twice as long as wide. Prothorax widest in front of middle, narrowing posteriorly; pronotum a little roughened on each side of median line in pigmented area near front margin, and along hind margin. Abdominal tergites 1 to 7 with dorsal ampullae finely asperate, with small shining areas, ampullae marked by two transverse folds and an anterior one marking off a narrowly fusiform transverse area (the shape is almost exactly as in Craighead's 1923 figure for the larva of *Anoplodera nitens* (Forster), pl.

Figure 26. Larva of *Centrodera spurca*. End of the abdomen in ventral view, showing the form of the ninth tergite with its single median tubercle.

XVII, fig. 5). Tergite 8 transversely wrinkled but without ampullae; tergite 9 irregularly wrinkled, median area before hind margin raised, somewhat triangularly tumid, with a single short mammillate tubercle at apex.

Legs about as long as labrum is wide, femur and tibiotarsus each twice as long as trochanter, unguiculus a little shorter than tibiotarsus; unguiculus pale in basal half, brown in apical half, with a strong seta arising laterally at apex of pale area and projecting beyond tip of segment. Eusternum somewhat triangular but with apex (cephalad) broadly rounded; mesosternum and metasternum each divided into two equal areas by a median transverse groove, surface finely asperate; abdominal sternites 1 to 7 each similarly divided by transverse groove, surface finely asperate, front half of each division with transverse lines of low tubercles, 5 on each side of median line of abdomen; sternites 8 and 9 with transverse rugae or wrinkles. Spiracles suborbicular.

In Duffy's key to Lepturinae (1953, p. 67) the larva runs to couplet 2, and agrees with the first part of the first choice in having a terminal spine on the 9th abdominal segment, and a divided frons, but does not agree as to the remaining characters. In Craighead's key (1923, p. 82) it traces to numbered couplet 1, but will not run to *Centrodera* in the second half because the gula is almost twice as long as wide and the abdomen has only one caudal spine; neither will it run to couplet 2.

The Pupa of *Centrodera spurca*

The following scanty observations are based on the cast skin of the reared male mentioned in the section "Life History."

Pronotum with marginal line of setae, probably with two linear discal groups, and scattered setae between them and marginal line. Metanotum with a group of about 35 setae on each side of median line; these are the longest and strongest setae on the pupa. Abdominal tergites with all setae long, slender, copper-colored as on rest of body. Abdominal tergites 1 to 5 each with two groups of about 14 slender setae on a tumid area on each side of median line, tergites 6 and 7 with about 12 setae in each group; tergite 8 with an undivided band of them, tergite 9 with 2 discal setae and numerous apical setae on each side apically. Apex of 9th abdominal tergite without urogomphi, but with two small seta-bearing tubercles, and a single median seta just beyond them. Femur with about 10 setae along outer face near apex; tarsus with a single seta near apex.

The larvae of *C. autumnata* and *C. dayi* are unknown, although the adults are common in at least parts of their ranges. The fact that there are no known rearings of either of these medium sized forest insects from trees, logs, or stumps suggests that the larvae may spend their lives in the soil;

possibly they feed on buried wood, or upon living roots, and almost certainly they pupate in the soil.

A Partial Life History of *Centrodera spurca*, with Notes on Other Species

Very little has been published on the life histories and habits of the species of *Centrodera*. In 1894 Hopkins (1894B, p. 150) cited the larvae of a species of cerambycid as causing extensive damage to the heartwood of both living and dead tulip trees [*Liriodendron tulipifera*] in West Virginia[6]. In 1896 (p. 245) he recorded having found a newly transformed adult in its pupal cell in the heartwood of a chestnut tree [*Castanea sp.*] and stated "This beetle was identified for me through the kindness of Mr. Howard, of the Division of Entomology, as *Centrodera bicolor*." This was an inadvertent error, as there is no such described species in the genus. His paper was republished in West Virginia with some changes in the text and the addition of a plate, in 1897 (pp. 143–152, pl. III), and the above sentence changed to read "This beetle was identified for me through the kindness of Dr. Howard, of the U. S. Division of Entomology, as *Centrodera decolorata*, Harr, by Mr. Linell."

In the next paragraph he recorded another example cut from a tulip log, and wrote that the species was "one of the most destructive wood-boring insects that infest the wood of living trees" previously wounded by fire. In another part of the 1897 report (p. 81) he called it the Destructive Heartwood Borer, while on page 97 he wrote "Trees of all kinds in all sections of the State that have been injured by fire or other causes, sufficient to induce a diseased condition of the wood adjoining the wound, often have the heartwood literally ruined by the destructive heartwood borer. This pest extends its destructive depredations to the sound wood, which results in the final decay of all of the inner portion. This is quite a serious trouble and causes the loss of a large amount of timber." Footnote 4: "*Centrodera decolonata* [*sic!*], Harr." [Refers to heartwood borer four lines above.]

If Hopkins correctly associated adults and damage by larvae, it is remarkable that the species has not gained subsequent attention. Craighead (1923, p. 85) repeated Hopkins' chestnut and tulip heartwood host records, but in his 1949 report did not mention the genus or the species.

Craighead *(loc. cit.)* also recorded the larvae of *C. decolorata* from old wet decaying oak logs (*Quercus* sp.) and a dead chestnut tree in Pennsylvania. He cited pupation from May to July, in "a round cell of frass constructed before pupation. An adult was reared in early September."

Wickham (1897B, p. 170) mentioned that the adults of *C. decolorata* occur on beech, and this was repeated by Felt (1906, pp. 428, 456) who

6. Also in an 1894 paper in *The Timberman*, which reference I have not seen.

also recorded it as cut from butternut and gave a figure of the beetle. Blatchley (1910, p. 1048) gave beech and maple, as did Procter (1946, p. 177). Morris (1916, p. 20) recorded the species on or from a maple stump. Leng (1928, p. 437) cited larvae in oak, chestnut, and tulip poplar. Beaulne (1932, p. 199) listed the larvae as injurious to the following host plants: apple, beech, maple, oak, chestnut; and Chagnon (1936, p. 209) as occurring in walnut [*Juglans cinerea*] and beech [*Fagus grandifolia*].

Knull (1932, p. 63) reported finding a teneral adult of *Centrodera picta* Haldeman in its pupal cell in the decayed part of a living yellow birch [*Betula lutea*] in September; in 1946 (p. 175) he recorded the adults as frequenting "flowers of mountain maple *(Acer spicatum)*." Smith (1900, p. 291; 1910, p. 330) gave "rare on dry hickory;". Felt (1906, p. 715) repeated Smith's record. Leng and Davis (1924, p. 59) also cited hickory and stated that *C. picta* had been taken flying to light on Staten Island, New York.

The larval habits of the North African *Apatophysis barbara* Lucas were described by Peyerimhoff (1926, pp. 351–352). He found them tunneling in a dead specimen of *Limoniastrum Guyonianum* (Plumbaginaceae), a desert tree, and caged a section, partially burying it in dampened sand. The larval stage lasted for at least seven years! During the intense heat of the summer they seemed to remain quiescent in their galleries in the wood, but in winter when the sand was cool they tunneled out and round about in it, perhaps looking for additional food supplies. Pupation took place both in the sand and in the wood, and adults emerged in May and June.

From what is now known, the larvae of *C. spurca* have some of the same habits. They commonly feed in rotting stumps and roots (and possibly on living roots) of several kinds of trees and shrubs; they wander freely through the soil, and pupate in the wood or in the soil as it suits them. Nothing is known of the larval stages of *C. autumnata* and *C. dayi*.

The first statement of a host plant for *C. spurca,* so far as I know, was by Garnett (1918, p. 212): "Breeds in *Pseudotsuga taxifolia.*" I have been unable to trace the source for his record, which was repeated by Essig (1926, p. 452), Hardy (1926A, p. 428; 1926B, p. 5), Doane *et al.* (1936, p. 177) and Canova (1936, p. 129). Later, on the basis of material collected by Mr. Lohbrunner, Hardy (1942, p. 10) was able to correct this.

In my field notebook for 1929 there is the following entry for April 25, at Salmon Arm, British Columbia: "1 *Parapachyta spurca;* this was found in the ground, & had changed very recently, as it was quite soft, & very white." Apparently I did not associate it with any rotting or other wood. There is a female in the collection of the University of British Columbia, labeled as taken in Victoria, B. C., January 28, 1917, by W. D. [W. Downes];

judging by the date it probably was dug out of the ground. I have seen a male and a female in the collection of the Provincial Museum of Natural History at Victoria labeled "Saanich, B. C., 14.II.35. Ed Lohbrunner. Dug out of ground near oak trees & Rosa nutkana." Hardy (1942, p. 10) wrote "Adults have been dug out of the ground in the vicinity of Garry oak trees among the roots of *Rosa nutkana* in February. Large larvae were found in gall-like swellings at the base of the rose bush but as I was unsuccessful in rearing them, proof as to their identity is lacking."

In a letter to me dated October 27, 1948, Mr. Hardy amplified this: "Although the host tree of *C. spurca* as I know it, is evidently Garry Oak, I have never been able to rear larvae found in the roots or base of trunk of these trees through to the adult; they have always died or disappeared in some way. I believe I mentioned in one of the B. C. proceedings that possible larvae and certainly the adults have been dug out of the ground at the base of the oaks in February and March, while I have several times taken large larvae presumed to be this species from burrows at the base of dying trees. This same type of larvae [*sic!*] has also been found in old roots of the wild rose growing near the oaks, so you will see that uncertainty is still rampant."

The statement by R. Hopping (? 1921, second page) that he had found *Pachyta spurca* breeding in six species of pine and some six species of shrubs in the Sierra of California, at altitudes of from 3000 to 4000 feet, is obviously a lapse of memory by the recording secretary, as to the genus and species concerned.

On May 16, 1954, I was enlarging a small hillside vegetable garden at 427 Rose Avenue, Mill Valley, California, and dug into a bank containing a stump of scrub oak, *Quercus Wislizeni* var. *frutescens*. The green tree had been felled some four years earlier. A peculiar burrow-inhabiting predaceous carabid larva was found, so a large tin was nearly filled with big lumps and smaller bits of earth from the site, and the larva put into a hollow at the top. Tightly lidded, the tin was taken into the house with the expectation that I would add food and rear the carabid.

Unfortunately I became ill with pneumonia, and the tin was not opened again until October 11. By then there was no sign of the carabid larva, but in searching for it I broke up all the lumps of soil, and was amazed to find a freshly transformed male of *C. spurca* in one (figs. 27, 28). This must have been in its pupal cell, presumably as a mature larva, when I picked up the lump in May. At this time I suspected that the larva might have been working in the oak stump, then left it to pupate in the soil, as Craighead (1923, p. 85) recorded for *Anthophilax* and some other genera.

By happy coincidence, on May 17, 1954, the late Gordon Stace Smith obtained a teneral female of *C. spurca*, and a larva in association with it,

Figure 27. Recently transformed male of *Centrodera spurca* in its pupal cell in a lump of soil excavated from a bank; see text for details. (Photograph by E. L. Kessel.)

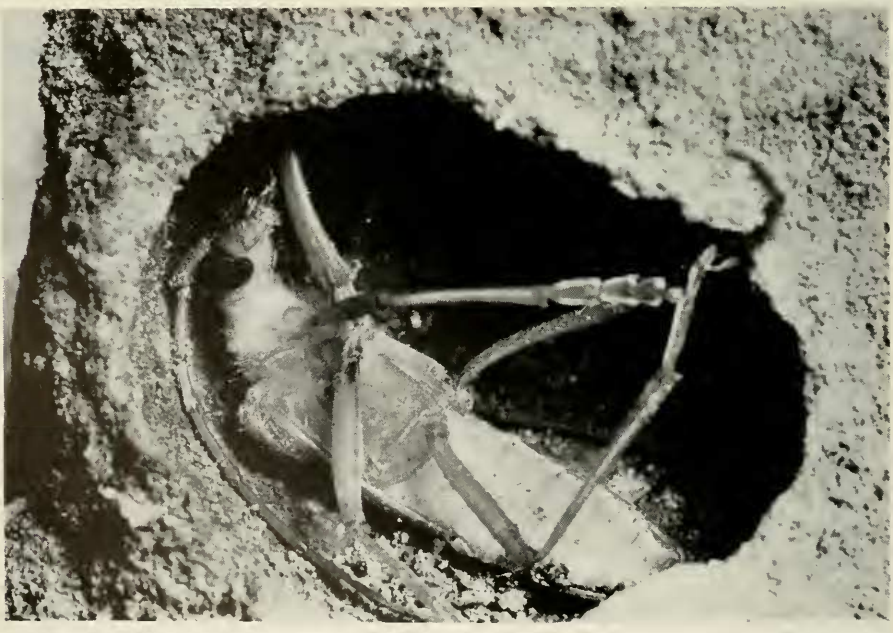


Figure 28. Close up of the teneral *Centrodera spurca* in its pupal cell. Note that the inner surface of the cell is unlined. (Photograph by E. L. Kessel.)

at Creston, British Columbia. In his letter of June 15 he wrote "Re *Centrodera spurca:* the *Amelanchier* roots where I took them were quite rotten, almost crumbling. Actually, the adult occupied only half itself [*sic!*] in the root, the other half in a sort of mud cell *under* the root. The larva was only an inch or so from the adult, but quite in the root. Now I have several times dug up larvae I believe the same, but could never before definitely associate them, though occasionally, adults have been so exposed. I assumed both were right in the soil, but probably in a fragment of rotten wood." There is a female in his collection, now at the University of British Columbia, labeled Creston, B.C., February 14, 1952, and "excavated from soil."

Another likely host may be mentioned. In the summer of 1931 my father found a larva feeding in the roots of a living Soopalallie *(Shepherdia canadensis;* Eleagnaceae) at Salmon Arm, British Columbia. On the basis of its size, and the known local cerambycid fauna, it had to be *Tragosoma depsarius* (Linnaeus) or *Centrodera spurca.* We failed to rear it, but since *T. depsarius* is known from conifers, I have little doubt that our larva was that of *C. spurca.*

The larval skin from the pupal cell of my reared Mill Valley specimen, with Mr. Stace Smith's larva, enabled me to identify an apparently mature larva found by my son Robin on January 24, 1954. It was dead, but in excellent condition, lying on the bottom of a small pool in Cascade Creek, Mill Valley. No doubt it had been washed by a freshet from its pupal cell in the stream bank.

On April 10, 1955, my son Thomas dug up a small pine tree planted as a seedling five years before; it was at the edge of a group of Coast Redwoods, *Sequoia sempervirens,* at our home in Mill Valley. In the process he uncovered a male of *C. spurca* and two larvae. One larva was in its pupal cell, and died there in late July without pupating. The other was free in the soil, 33 mm. long, and possibly immature; it is shown in fig. 24. All were in soil interlaced with small roots, including those of redwood, madroño *(Arbutus Menziesii)* and hazel *(Corylus californicus),* but no oak. We did not notice anything else in the soil, other than humus, on which the larvae could have fed. This, coupled with Hardy's records of oak and wild rose, and Stace Smith's of service berry, suggest that they may be general feeders, or that like the African *Apatophysis barbara* they may wander through the soil for some distance from their main food supply.

Since the above was written I have seen a female [USNM] which has the following label data "San Mateo Co. Cal., larva collected II.17.1935. larval host dead Madrone stump. Taken out of pupal cells on X.4.34. P. C. Ting Collector. Asc No. 81. Parapachyta spurca (Lec.) det. P.C. T." Mr. Ting tells me that the file of notes in which the original data were contained was destroyed in a flood at Reno, Nevada; so it is impossible to tell which of

the above year dates is correct. At any rate, he appears to have made the first definite association of larvae and adults.

The finding of two sizes of larvae and an adult at the same site in April, at Mill Valley[7], and an adult in its pupal cell in October, makes it fairly sure that the life cycle takes at least two years. Some mature larvae must form their pupal cells, pupate, and tranform into adults, in the fall. However, the fact that in the San Francisco Bay area of California the species is on the wing over a period of four months (table I) suggests that some larvae may not pupate until the spring. Adults of the other two species (tables II, III) are most numerous later in the year than is *C. spurca,* and presumably overwinter as larvae only; Linsley (1961, p. 9) remarks that "Species which are active in late spring, summer, and fall usually pupate shortly before emergence, remaining in the cell as adults for only a short time."

The pupal cell shown in figs. 27, 28 is completely unlined, its inner surface appearing as if pressed and rubbed or tamped smooth by the larva when the soil was damp.

Where the females lay their eggs is unknown. I made several attempts to follow flying specimens at night, with the aid of a strong flashlight, but that is not easily done on a wooded hillside, and they always disappeared. On the basis of larval habitat it is likely that the eggs are laid in the soil, as are those of at least some species of the Old World genus *Apatophysis,* which Gressitt considered to be a subgenus of *Centrodera.* Certainly the males resemble species of the *C. spurca* group, but perhaps we should not expect the egg laying habits to coincide, because as Butovitch has remarked (1939, p. 225) the species of *Apatophysis* are desert-inhabiting forms in which the females show morphological adaptations similar to those of desert prionids: elongated abdomen, widely separated hind legs, shortened elytra and very long ovipositor.

There are no published records as to the longevity of the adults of *Centrodera.* My only information is based on a female of *C. spurca* of unknown age, collected at light in Mill Valley, California, on June 20. She was kept in a jar containing some damp sand and sawdust, and lived until July 14; her only source of food was a very weak solution of honey.

Flight Periods of the Adults of the *Centrodera spurca* Group

Centrodera spurca is a species of late spring and summer. Ninety-nine per cent of the 1061 specimens studied were taken during the months of May–August, inclusive, and 87 per cent of them in June and July. There are a few exceptional records; E. I. Schlinger took a female at Glendale,

7. In early April, 1959, Dr. E. S. Ross dug up several adults of *C. spurca* at his property in Mill Valley, an additional record.

Los Angeles County, California, March 21, 1947 [UCD], and E. A. Dodge found a female at Santa Cruz, Santa Cruz County on "III.17," which may have been March 17, or March, 1917. It is possible that both these specimens were found in the soil, and are not actual flight appearances, since one would expect males to be out before females. However, exceptional climatic conditions may bring out beetles which have pupated in exposed situations. For instance E. S. Ross mentioned to me on April 6, 1959, that he had recently dug up several adults of *C. spurca* in Mill Valley, Marin County, California, and that a specimen had come to light at his window "at least two weeks ago," *i.e.* during the last week of March. There had been an exceptionally warm spell during the second half of March that year.

Table I summarizes the dates of capture of the examples of *C. spurca* seen by me, arranged by geographic regions from north to south, with divisions east and west where the records permit. The main emergence is obviously in June and July, both on the coast and in the mountains, but it is interesting to compare the totals of males and females for each of the two months. It is surprising how many males are still around in August.

Following are the "First of season" records for specimens attracted to our (indoor) house lights at 427 Rose Avenue, Mill Valley: 1950 (May 11), 1951 (May 8), 1952 (May 6), 1953 (May 3), 1954 (May 3), 1955 (May 11), 1956 (May 14), 1957 (April 28), 1958 (May 13), 1959 (May 5). All these specimens were males. Of course it is uncertain that our lights attracted the actual first emergents of the area.

Another point brought out in table I has to do with northern distribution. Although *C. spurca* is common enough on southern Vancouver Island, British Columbia (of 39 specimens, my most northerly records are in about the same latitude for the inner and outer coasts, Nanaimo and Ucluelet respectively), and equally common in the southern interior of the mainland (Seton Lake to Creston), I have no records for the mainland west of the coast mountains. Neither is the species in Stace Smith's lists (1929, 1930) of the beetles from Copper Mountain, near Princeton and just east of the mountains. Yet the Vancouver area and the Lower Fraser Valley have had resident collectors for well over 60 years. I have not seen enough material from northwestern Washington to know how far south of British Columbia this state of affairs continues.

Centrodera autumnata is common during July, August and September, reaching its peak in August, by which time most *C. spurca* have disappeared. I took one male at Mill Valley on June 28, 1959, and have seen a male and a female from Ben Lomond dated June 3, 1946; this surprisingly early date is substantiated by a single male taken at light at Mill Valley on May 29, 1958. The first specimen for 1954 is dated July 11, and that for 1957, July

TABLE I. *Captures of* Centrodera spurca *adults by months, regionally.*

Centrodera spurca LeConte	March		April		May		June		July		August		Sept.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
British Columbia: Vancouver Island	—	—	—	—	2	—	21	4	2	10	—	—	—	—
British Columbia: mainland west of coast mountains	—	—	—	—	—	—	—	—	—	—	—	—	—	—
British Columbia: mainland east of coast mountains	—	—	—	—	4	2	17	7	3	12	—	1	—	—
Washington: west of Cascade mts.	—	—	2	—	4	—	5	2	2	5	1	—	—	—
Washington: east of Cascade mts.	—	—	—	—	4	2	16	22	12	7	—	—	—	—
Oregon: west of Cascade mts.	—	—	—	—	5	—	19	8	14	9	—	2	—	—
Oregon: east of Cascade mts.	—	—	—	—	3	1	8	7	4	14	—	—	—	—
Idaho	—	—	—	—	4	—	7	4	14	11	3	1	1	—

TABLE I. (continued)

	March		April		May		June		July		August		Sept.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
California: coast, east to Trinity Co., and from north boundary south to Marin Co., inclusive	—	—	1	—	22	2	28	14	9	10	1	4	—	—
California: coast, San Francisco and Contra Costa Co., south to San Diego Co.	—	2	2	—	8	2	48	19	75	55	19	3	—	1
California: NE. mts.: Cascades, east and south through Siskiyou, Modoc, Shasta, Tehama and Lassen counties	—	—	—	—	2	—	51	15	43	36	—	1	—	—
California: Sierra Nevada: Plumas Co., south to Tulare, Inyo and Kern counties	—	—	—	—	1	—	52	15	108	80	3	4	—	—
Nevada	—	—	—	—	—	—	3	2	—	—	—	—	—	—
TOTALS	—	2	5	—	59	9	275	119	286	249	27	16	1	1

Table II. *Captures of adults of* Centrodera autumnata *by months, regionally.*

Centrodera autumnata, new species	May		June		July		August		Sept.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
California: Humboldt County, south to south shore of Marin County	1	—	2	—	16	1	94	10	14	1
California: San Francisco Co. south to Monterey County	—	—	2	1	26	4	24	4	1	2
California: San Luis Obispo Co. south to San Diego County	—	—	—	—	2	—	4	—	—	1
TOTALS	1	—	2	1	44	5	122	14	15	4

Table III. *Captures of* Centrodera dayi *adults by months, regionally.*

Centrodera dayi, new species	June		July		August		Sept.	
	♂	♀	♂	♀	♂	♀	♂	♀
Washington: west of Cascades	—	—	—	—	—	—	—	—
Washington: east of Cascades	—	—	1	2	3	—	—	—
Oregon: west of Cascades	—	—	5	4	4	9	—	—
Oregon: east of Cascades, including Medford, Talent	1	—	3	1	12	17	—	—
California: Cascade mts., east and south to Lassen Co.; also to Yolo Co. on west side of Central Valley	—	—	—	1	7	11	—	—
California: Sierra Nevada. Plumas Co. south to Tuolumne Co.	—	1	2	2	4	4	—	—
TOTALS	1	1	11	10	30	41	—	—

4. These early emergences are probably due to the same causes as in *C. spurca, q.v.*

The records are summarized in table II. Note the surprising disparity in the numbers of females as compared to males in this species, in constrast with the totals for *C. spurca* and *C. dayi* in tables I and III. Of course this is not a true figure of the proportions of the sexes, but only of relative attraction to light, though it may indicate a difference in habitat in *C. autumnata* females.

As shown in table III, *C. dayi* appears to have a remarkably short flight period. Of the 94 specimens studied, from southern Washington to central California, all but two were collected in July and August, with by far the greatest number in August. Of course there are fewer collectors in the field during September than in the summer, but this fact hardly explains the complete lack of September records.

Habits of the Adults of *Centrodera* spp.

Daytime retreats. The adults of *C. spurca, C. autumnata* and *C. dayi* are nocturnal; although fewer than half of those seen are documented as having been taken at light, I suspect that at least ninety per cent were collected in this manner. One is occasionally found in plain sight during the day, near an electric light which has been on all night, but they normally hide successfully.

To the best of my knowledge the only person to take specimens of *C. spurca* during the day on a number of occasions has been that outstanding collector, the late Gordon Stace Smith. In a letter to me of September 7, 1948, about finding them at Creston, British Columbia, he stated that the best way was to beat the overhanging branches of Douglas fir *(Pseudotsuga Menziesii),* but that he had beaten them also from cedar *(Thuja plicata),* aspen *(Populus tremuloides),* choke cherry *(Prunus virginiana* var. *demissa)* and willow (*Salix* sp.). One of the specimens in his collection [UBC] is labeled as from hazel (*Corylus* sp).

More unusual are two males and a female [WSU] labeled "Moscow Mt., Ida. May 1935. Ground squirrel burrow." Unless the female fell in while looking for an oviposition site, and the males followed her, this record is hard to explain. Possibly they all pupated in the soil adjacent to the rodent's tunnel, and emerged into it.

Attraction to Light. I suspect that all the western species of *Centrodera* are crepuscular or nocturnal, and know that at least five of them are attracted to light. The coarsely faceted eyes of the eastern species suggest that they too are nocturnal, and Professor J. N. Knull *(in litt.,* 1962) states that *C. sublineata* LeConte comes to light, while Engelhardt (1942, p. 38) records a specimen so taken at Middletown, Virginia, April 13. Hatch

(1925, p. 579) lists *C. decolorata* as taken at light, and Leng and Davis (1924, p. 59) cited *C. picta.*

Centrodera spurca has several times been recorded as attracted to light. For instance Garnett (1918, p. 212) wrote "It flys [*sic!*] at night and is attracted to light." Hardy (1926A, p. C28; 1926B, p. 5) said "Taken only at 'light.' Occasional. Latter part of May to July." Doane *et al.* (1936, p. 176), ". . . frequently flies to light." Moore (1937, p. 88), "Taken by the author at lights in San Diego in April and July." It is interesting to compare the ratios of males to females in collections, by species, as shown in the foregoing tables. This suggests either that females of *C. autumnata* are much less attracted to light than are the males (and are females of other species), or that they stay near the egg-laying sites while the males range widely.

My own experience with *C. spurca* and *C. autumnata* is that they are much attracted to light, especially of a rather low intensity. In season they appeared on the windows of, or entered, rooms in which there were at various times 1) one or more exposed regular 100-watt electric light globes, or 2) only shaded reading lamps with similar globes, or 3) lights on the same walls as the windows and thus not directly visible from outside, or 4) two 20-watt fluorescent light tubes. They were also attracted to an outdoor light trap using a standard 300-watt globe. These species and *C. dayi* have all been taken at single-mantle "Coleman" gasoline lanterns. I have had examples of both *C. autumnata* and *C. spurca* fly to the same "Coleman" lantern of an evening in places as widely separated as Mill Valley, Marin County (altitude about 625 feet; mid-July), and just below the top of Junipero Serra peak in the Santa Lucia mountains of Monterey County (altitude approximately 5800 feet; mid-August). Examples of both *C. spurca* and *C. dayi* from Oregon and California have been seen labeled as taken at black (ultra violet) light, and I have so taken *C. spurca* at Mill Valley, California, in June and July.

On the other hand, using a 500-watt "Photoflood" globe in a metal reflector from 9 to 10 P.M. on August 25, 1950, I watched examples of *C. autumnata* on the trees by our house in Mill Valley. They were in all cases flying to and settling on the branches of living madroño *(Arbutus Menziesii)* trees, ten to fifteen feet above the ground; one landed on a spray of fruits and investigated it for some time, but did not appear to eat any of the berries. The beetles did not seem to be in any way disturbed by the bright light, and not one of them flew to it.

Mazkhin-Porshnyakov (1960) has proposed a most interesting theory of why insects fly to light at night. As he points out, "insects fly not only to a radial source of light rays, for instance, a lamp, but also to diffuse light reflected from a screen."

The following quotation is from his summary. "It is very probable that light attracts insects only because it is a sign of open space, or an absence of restraints. In nature open spaces are much better illuminated than closed ones and they attract insects because there are no obstacles to avoid. Thus they can orient themselves more easily in the carrying out of one or another of their vital functions. During their life insects constantly make use of brighter illumination as an indicator of open space (exit from cavities, from dense vegetation, etc.).

"Open space is characterized, above all, by an abundance of short-wave, generally ultraviolet rays. The source of these rays during the night appears to be the sky—an orienting source which leads to open space. The greater the quantity of short-wave rays (including ultraviolet rays) an artificial light contains, the more readily it attracts nocturnal insects. Such illumination is similar to, but brighter than, natural light at night."

Ability to Walk on Vertical Panes of Glass. There have been a number of papers written on the abilities of certain insects to hold onto or walk up very smooth surfaces. In the adephagous, silphoid, and some other groups of beetles it is not uncommon to find isolated or grouped specialized sucker-like hairs on the tarsi, especially on the fore tarsi, and often only in the males. Miall (1903, pp. 53–59) gives an interesting discussion of some of the problems involved in understanding how these suckers act.

One is surprised to find that the matter is still puzzling entomologists and seems not to be resolved. Curran (1958, p. 85), in considering the pulvilli of flies and how the insects land on ceilings, concludes "The contention that the puvilli are sticky is almost certainly mistaken. What is certain is that the pads act as suction cups, serving to anchor the fly firmly." The subject was fully discussed, with the same conclusions, by Kirby and Spence nearly 150 years ago.

Not having investigated the matter in detail, I wish merely to draw attention to the fact that both sexes of *C. spurca* and of *C. autumnata* are able to land on and hold to a vertical window glass, from full flight. I do not know whether the hairs of the tarsal pads have suction cup tips, or exude an adhesive, but suspect the former type. I have seen a male *C. spurca* so "stuck" to a window pane by one foot, by his own doing, that he could not release himself, but could only slide slowly down the glass. One is tempted to explain this by the analogy of sliding a rubber suction cup on glass.

Adults on Flowers. No records of *C. spurca* or allies having been taken on flowers are known to me. In fact I do not recall flower records for any west-coast nocturnal Cerambycidae, though many of the diurnal species, especially in the Lepturini, are pollen feeders. It is thus interesting that

during the course of this study pollen has been found on examples of all three species of the *C. spurca* group.

Some males of *C. autumnata* have carried enough of it to obscure the surface of the prosternum, and the depression between the clypeus and the antennal bases. Pollen has been noted on the head (base of clypeus and near, genae, occiput, first three antennal segments, submentum—but not on the mouthparts, which are perhaps most easily cleaned), sides of prothorax, pro-, meso- and metasternum, fore and middle coxae, and the femora of all legs. The distribution suggests that the beetles may have been probing or feeding on floral parts, but not necessarily on pollen.

Mr. Robbin Thorp at the University of California, Berkeley, has been so kind as to examine samples of the pollen which he removed from the beetles. He reported that specimens of *C. autumnata* from Mill Valley, Marin County, California (mid-August) carry a common type found in several plant families. After eliminating groups not occurring in Marin County, and those not in bloom while the beetles were active, he suggests the following as probable sources of the pollen; my comments are in parentheses.

Fagaceae. *Lithocarpus* sp. (Tanbark oak, closely allied to *Quercus*. There is only one species, *L. densiflorus* Rehd.; it is common at 427 Rose Avenue, where the beetles were collected.)

Fagaceae. *Castanopsis* sp. (Chinquapin. A single species in the area, *C. chrysophylla,* but much less common than tanbark oak.)

Caprifoliaceae. *Sambucus* sp. (Elderberry. Two species in Mill Valley, *S. callicarpa,* red fruited, and *S. coerulea,* blue fruited. Neither species is known to occur close to the collecting site.)

A female of *C. dayi* from Medford, Jackson County, Oregon, August 29, carries pollen similar to that on the *C. autumnata* males, as do a male and a female of *C. spurca* from Mount Hermon, Santa Cruz County, California, July 16. Both these latter have a good covering of pollen on the pro- and mesosternum and adjacent parts, and dorsally on the head.

A male of *C. spurca* from Johnsville, Plumas County, California, July 21, has a scattering of pollen which Mr. Thorp identifies as *Pinus* sp., probably lodgepole pine, *P. contorta* var. *murrayana,* on the pro-, meso- and metasternum and adjacent areas. Two other males and three females from the same place, taken on three different dates in July, also have *Pinus* sp. pollen. One female has a good deal, including on the femora, tibiae and pronotum. Four males and four females from Twain Harte, Tuolumne County, California, late June to late July, each show a little *Pinus* sp. pollen ventrally.

Since all western species of *Centrodera* are to the best my knowledge crepuscular or nocturnal, it was a surprise to read in Knull (1946, p. 175)

that in the eastern *C. picta* "Adults frequent flowers of mountain maple *(Acer spicatum* Lam.)." In a letter dated February 22, 1962, Professor Knull verified this statement, remarking that he had so taken them in southern Pennsylvania, and that he had collected isolated specimens by beating foliage. On the basis of such diurnal habits, it is a surprise to find that Leng and Davis (1924, p. 59) record examples of *C. picta* as having flown to light at Clove Valley, Staten Island, New York, June 7. Is it possible there is a sibling species involved? Certainly the specimens of *C. picta* I have examined differ from the rest of the species in the structure of the prosternum, and perhaps do not belong in *Centrodera.*

Attraction of Some Western Species to Baits. Currie (1904, p. 28) recorded having taken *Pachyta spurca* LeConte while "sugaring" for moths at Kaslo, Kootenay Lake, British Columbia, during the summer of 1903. He used a mixture of 3 pounds of sugar and 1 pound of molasses, boiled till the sugar was dissolved, then thinned with beer and a small glass of rum. Among specimens from Quamichan Lake, Vancouver Island, British Columbia (Hanham Collection, PMV) there is a male of *C. spurca* labeled "at sugar."

Mr. L. G. Gentner took the following specimens at Talent, Oregon: a male of *C. spurca* "In codling moth bait pan" on 11.V.1936 [CIS] and another on 19.VII.1938 [LGG], a female "In bait pan" on 3.VII.1941 [LGG] and another on 31.VII.1941 [UCD]. Also a male [UCD] and a female [LGG] of *C. dayi* on 24.VII.1938, both "In c. moth bait pan." The bait was made of 1 quart of Fleischmann's Diamalt and 19 quarts of water, giving 5 gallons of solution, to which 2 cakes of Fleischmann's yeast were added, and the mixture allowed to ferment. It was placed in open sauce pans which were suspended in the upper third of the fruit trees (Gentner, *in litt.,* 1962).

One female of *C. dayi* from Monroe, Benton County, Oregon, 23.VII. 1931 (N. P. Larson, OSU) is labeled "In moth trap." Judging by the condition of this specimen, and of a male taken 17 days earlier, both were collected from liquid bait traps.

Stridulation. Typical of the Cerambycinae, there is in *C. spurca* a longitudinal tumid dark area on each side of the median line of the prescutum, the two forming a *pars stridens,* the surface of which is uniformly covered with fine transverse ridges.

Each time the prothorax is moved backward and forward a ridge (plectrum) on the underside of its hind margin is drawn across these striated plates, producing a squeaking noise. It can be heard easily when live specimens of *C. spurca* and *C. autumnata* are held or restricted in their movements, and equally by moving the parts of a dead, relaxed specimen.

Examination of the *pars stridens* in the three species of the *C. spurca*

group has shown too much variation in its form to offer specific separations.

COPULATION. On August 16, 1954 a male and a female of *C. autumnata* were taken as they came to light separately at Novato, Marin County, California. The next day they were released together; the male attempted copulation immediately, and the act was observed with the aid of a stereoscopic microscope.

The male mounted the back of the female from behind and took a position such that his head was almost at the basal one quarter of her elytra. Bending the tip of his abdomen down to contact hers, he extruded his parameres enough to catch against the tip of her fifth abdominal sternite, then inserted the tip of the aedeagus between this sternite and her eighth visible tergite (pygidium) and pulled upward.

At all times during the copulation the hairs of the parameres caught against and pushed down the rim of the fifth sternite, while the aedeagus pulled up on the pygidium. With these segments held apart, the intromittent organ was inserted into the tip of the ovipositor, which the female kept retracted except when she tried to prevent copulation, or terminated it by extending the ovipositor beyond the point to which the intromittent organ could reach.

These copulatory actions differ from any cited in Butovitsch's summary for the Cerambycidae.

Alexander (1962, p. 66) noted that the parameres of beetles have often been interpreted as pries; but on the basis of his observation of a mating in the carabid *Pasimachus punctulatus* Haldeman he is inclined (1959, p. 485) toward Jeannel's view that they are chiefly of use in producing tactile sensory effects upon the female. There is surely no doubt that this latter is true; but it is equally certain that at least in *C. autumnata* (and on the basis of similarities in structures, probably in many Cerambycidae), they are used not as true pries but as holders or pushers.

A pairing of *C. spurca* has also been observed. In this case the female was more receptive; after a quick push down with the parameres and pull upward with the tip of the aedeagus, the male extruded and inserted his intromittent organ, then retracted the parameres and aedeagus. The action up to this point was so fast that there was no chance for the parameres to be effective as tactile exciters, and they were not so used thereafter. The female remained quiescent; the intromittent organ was inserted almost up to the paired armatures (for a comparable example see the excellent fig. 8 on p. 27 of Jeannel's 1955 paper), at which point it became enlarged and somewhat bulbous. The apex of the aedeagus and the parameres barely extruded from the abdomen, and thus the tips of the abdomens of the copulating beetles were separated by between one and two millimeters, the length

of the everted intromittent organ between the paired armatures and the ostium at the apex of the aedeagus.

The male mounted the female so that his mandibles touched the tip of her scutellum. His front tarsi wrapped around her prothorax a little below the lateral tubercles, the claws holding at the median line just in front of her front coxae; his middle legs encircled her body, the tarsi closely in front of her hind femora, and his hind legs clasped her abdomen. The pair remained *in copula* for twelve minutes.

The positioning of the male with his mandibles at the female's scutellum may be significant. Michelsen (1958, p. 350) reported that in *Rhagium bifasciatum* Fabricius and *R. mordax* DeGeer the males "lick" the scutellar and adjacent areas of the females with their mouthparts, to calm them during courtship. In *R. bifasciatum*, only "licking" near the scutellum was effective, while in *R. mordax* any upper part of the elytra gave results. Males of *R. bifasciatum* never protrude the genital organs more than 1 millimeter, so that the abdominal tips of the sexes are close together during copulation; thus a male larger than the female would be forced to "lick" in front of the effective area, and fail to mate successfully. In *R. mordax* the male genital organs are protruded several millimeters, giving more latitude of movement, so that the size of the male relative to the female is less important..

No such attempt to quiet the female occurred in the pairing of *Centrodera spurca* reported above, though the male's mouthparts were adjacent to the scutellum of the female. No "licking" was observed in *C. autumnata,* but neither was it watched for. In *C. spurca* especially, there is such a range of sizes in both sexes that I doubt a "licking" or similar process is essential to suceessful matings.

Dubious Records

Among the 1364 examples of *C. spurca, C. autumnata* and *C. dayi* personally seen[8], two short series carried what surely must be erroneous loeality labels. These were two specimens of *C. spurca* said to be from the Mackenzie River, Northwest Territories, Canada, and four of *C. autumnata* labeled Patagonia, Arizona. In addition two others are suspeet. A single male of *C. autumnata* is labeled "Orinda, Cal." Contra Costa County, with an illegible year date only, and no collector's name. Of 209 specimens of *C. autumnata* seen, this is the only one from the east side of San Francisco Bay proper, an area which has had resident collectors for more than 75 years. Although the record seems distributionally probable, I prefer to

8. This figure does not tally with the totals from tables I, II, and III. This is because of specimens which were adequate for study but lacked data as to month of collection, or were from places which I could not find in any gazetteers.

await fully documented specimens before accepting it. A female of *C. spurca* is labeled Salt Lake City, Utah; it has been included on the map (fig. 14), but is a long way from other known localities for the species.

A few dates of collection are puzzling, and may be the results of labeling from memory some time after the actual collecting. Such records are not used in the tabulations of captures.

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[The meeting was held on August 20, 1910, but the date of publication of the Proceedings is uncertain, and may have been earlier than 1921. See MacSwain, Pan-Pacific Entomologist, vol. 27, no. 3, p. 109; 1951. The signature in which Baumberger's list appeared consisted of 8 unnumbered pages.]

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[This slip of corrigenda and addenda gives page references to the Provincial Museum Report, as above, and to the separately paged reprint, for which see next item.]

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[Page 4 ends with "(To be continued.)" after *Leptura obliterata* Hald. At some time, presumably between the issuing of no. 6 in June 1907, and no. 7 in September 1907, a separately published "Page 4 continued" was published. It completes the list of Cerambycidae, and gives additions to earlier lists of Neuroptera and Lepidoptera. It is all on one long page, 1¾ inches longer than p. 4. Reprinted in 1926; see next item.]

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[According to the table of contents for vol. 1 N. S., part 4 was published in January, 1850. LeConte's paper was continued in vol. 2, pt. 1, pp. 5–38; in pt. 2, pp. 99–112 and 139–178. The table of contents for vol. 2 N. S. shows that pt. 1 was issued in November, 1850, but a footnote on the table of contents states "Extra copies printed for the Author, March, 1850." Part 2 was published in January, 1852, and the footnotes show that extra copies of pp. 99–112 were made for LeConte in October, 1851, and of pp. 139–178 in January, 1852. Presuming that LeConte distributed these preprints as received, it is possible that the species in pp. 5–38 should date from March, 1850, and those in pp. 99–112 from October, 1851, not January 1852.]

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